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All records for heavy locomotives will be surpassed when the Erie Railroad receives from the American Locomotive Company next April three Mallet compounds which have just been ordered. This type of locomotive was first introduced in this country on the Baltimore & Ohio, where the one engine in service has been working on mountain grades east of Pittsburg for about two years. While the results have been satisfactory as regards maintenance and cost of operation, it is significant that the Baltimore & Ohio has not ordered more locomotives of the same type. Last week we described the Mallet compounds which the Baldwin Locomotive Works are building for the Great Northern, to be used on the steep grades over the Rocky Mountains. The Great Northern engines, which are the heaviest yet built, have a total weight of 355,000 lbs., with 316,000 lbs. on the drivers, and a tractive effort of 71,600 lbs. The locomotives for the Erie will weigh 410,000 lbs., all carried on 16 driving wheels divided into two groups of eight wheels each. They will be used between Hornellsville, N. Y., and Susquehanna, Pa., where the grades are steep and the line full of curves. It is proposed to haul 2,000-ton trains without pushers. The locomotives will have a tractive power of 98,000 lbs., and will be able to haul about 175 loaded cars on level track.

Last year 7,500,000 ties, or about 10 per cent. of the total number laid in track, were treated by some preservative process, according to a recent bulletin of the Department of Agriculture. Most of these ties were laid in the Middle West, where the supply of hardwood timber suitable for ties has almost disappeared. Ten railroads now have their own tie-treating plants and others are planning to build similar works for their exclusive use. Straight creosoting and the somewhat cheaper process of zinc and creosote combined are now in most general favor. Mr. Octave Chanute in discussing a recent paper by Mr. W. C. Cushing on the treatment of tie timber, warns prospective users of the creosoting process against too small doses of this costly antiseptic. He gives some figures showing the life of creosoted ties on the Western Railway of France, where the process has been in use for more than forty years. Beech ties laid down in 1865 which were treated with from 40 to 48 lbs. of antiseptic per tie when taken up 25 years later were in perfect condition. In 1878, in order to reduce the cost of the treatment, the amount of creosote injected was brought down from 26 to 33 lbs. At the end of three years some of the ties began to decay, and after five years a large number were removed. After this experience the amount of antiseptic injected was again increased to 39 lbs. and later to 48 lbs. as a minimum.

The Interstate Commerce Commission and the railroads are working together to devise regulations for filing and posting tariff schedules and classifications that will give shippers and passengers full information about all rates without imposing undue expense on the roads or needlessly increasing the difficult changes in rates. One of the complaints under the old law was that schedules, as filed and posted in stations, could be understood only by experts. As the new rate law requires schedules to include more information, it will make them still more complicated and difficult to understand unless some means of simplifying them can be devised. The object of the law in requiring schedules of rates to be filed with the Commission and posted in stations is to insure equality of treatment to all passengers and shippers. It is to the interest of all concerned to allow the roads the utmost liberty, consistent with insuring this equality, as to changing their rates. Such liberty tends to gradual reduction in rates, for a carrier will be restrained from reducing a rate if the reduction itself entails expense and it cannot be restored again without still more expense. The recognition of this fact led the Commission, under the old law, to approve the system of changing rates by filing and posting supplementary tariffs, thus relieving the roads of the great expense of reprinting their entire schedules every time a change was made. Most of the complaints about the difficulty of understanding the published tariffs have been based on the multiplicity of these supplements. One of the problems now being considered is as to what limit, if any, shall be placed on the number of supplements which can be filed before the entire tariff or classification must be reprinted. The Commission was at first disposed to limit the number of supplements to any tariff to five and the number to any classification to ten, but it is now likely that a broader rule will be adopted. To require reprinting of an entire schedule after every five changes would tend to petrify rates almost

as much as a complete prohibition of amendments. A suggestion that may have some merit is that a loose-leaf system be adopted, so that changes could be made by reprinting only the sheet or sheets on which the new rates appeared. These new sheets could then be inserted in the schedule in place of the sheets that had been superseded and the schedule kept up to date without any supplements whatever. The Commission, recognizing the difficulties of the question and the desirability of expert advice, invited the roads to make suggestions and gave a hearing on the subject last week. At this hearing it was made clear that both the Commission and the roads were disposed to work in harmony, that the Commission desired to enforce the law without imposing unnecessary hardships on the roads or unduly restricting their freedom to change rates, and that the roads were ready to observe in good faith any reasonable regulations made by the Commission. An understanding was reached in accordance with which schedule experts to be selected by the roads will meet experts to be selected by the Commission, and after considering the entire subject of schedule regulations will make recommendations to the Commission. Under this arrangement the railroads are to select one passenger expert and one freight expert from each of the four classification divisions into which the country is divided. This action by the Commission and the railroads affords additional ground for the belief that both sides are determined to do all in their power to make the new law effective and to avoid friction under it.

A peculiar instance of corrosion of crown sheet staybolts in a locomotive boiler was recently brought to our attention. The locomotive was a rather small, radial-stayed, narrow-firebox switcher on a road in the Central West. It had seen a good many years of service, and had been neglected in the matter of repairs, particularly boiler repairs. A change of mechanical officers occurred, and the new head of the motive power department ordered the engine into the shop for a new firebox. Removal of the old firebox disclosed a condition of some of the crown sheet stays that was surprising and puzzling. The bolts affected included three longitudinal rows on both the right and left-hand sides of the sheet, correspondingly located and nearer the side than the center. Beginning about an inch above the sheet these bolts were eaten away for perhaps an inch of their length until their diameter at the affected point was reduced one-half, on the average. Some of the bolts had already parted before the box was removed, while others were not so deeply corroded as the average; but every bolt in the rows mentioned was affected, and the action was confined to these rows. The mechanical officers were never able to discover the cause of the condition, nor have they any satisfactory theory to account for it. If there is any other case of the sort on record we do not know of it. The fact that the action was symmetrical with reference to the center lines of the crown sheet—affecting like rows in number and position on each side—suggested the possibility of some peculiar condition of circulation being responsible in some degree, though it is not easy to imagine how that condition might have been brought about. Perhaps some readers may know of similar cases or have theories or knowledge on the subject which would be of interest.

WHEN BRAKES FAIL TO WORK.

Two recent passenger train wrecks, caused by failure of the brakes to work, have been attributed to the closing of an angle cock in the brake-pipe, thus cutting out the air-brakes on the rear cars. In the butting collision on the Canadian Pacific, near Sudbury, Ont., September 12, the brakes on three heavy sleeping cars and a dining car failed to work on approaching a meeting point and the engineer was unable to control the speed of his train which ran into another passenger train headed in the opposite direction, killing 12 persons and injuring 20. At Eddington, Pa., on the Pennsylvania Railroad, September 29, three persons were killed and 30 injured in a rear end collision. A train had stopped on account of defective brakes and the following train could not be stopped before running into it. After the accident an angle cock was found closed between the third and fourth cars, cutting off the engineman's control of the brakes on the last three cars of the train, all heavy Pullman cars. The evidence seems to show that in both cases the closing of the angle cock was accidental and not due to carelessness or malicious tampering. Such accidents are a rare but not unknown danger which has baffled the efforts of railroad men and inventors for 25 years.

With the enormous increase in the number of air-brakes in service since their use was extended from passenger trains to freight trains, the number of runaways and collisions due to the closing of an angle cock somewhere in the train has largely increased, although the aggregate number is still small. Of the total number of cases of closed cocks which have caused damage the large percentage, probably above 95 per cent., has been due to mistakes or carelessness of trainmen in not making sure that all cocks were open before the train started. Such cases can only be corrected and prevented by severe and constant discipline. But there are cases of accidental closing, even though the number be small. It is possible that officers in charge of this department have been too much influenced by percentages and, having other troubles which they could not settle to within 95 per cent. of perfection, would naturally devote a large share of their attention to these other and more pressing problems. It is this 5 per cent. of dangerous imperfection that we speak of now.

In the early development of the air-brake a simple horizontal plug cock was put in at the end of the brake-pipe under each car. The handle was placed to hang downward by the side of the cock when open, so that it would always tend to remain open by gravity and could not be jarred shut. As a further safeguard against accidental closing by an object flying up from the track and striking the handle, of which cases were not unknown, the Pennsylvania Railroad introduced a sheet of metal or shield placed in front of the handle. This device was later widely adopted.

When the quick-action air-brake was perfected some years later all the old plug cocks were removed and replaced with the present form of angle cock. The feature of a curved handle bent to conform to the shape of the cock body and lying close to and over the pipe when the cock was open was patented at the time as a safety device on the valve. Inventors were then working, and are still working, to provide a safeguard which should prevent disaster either from the negligence of a trainman, accident or malice of a trespasser, failure of the parts themselves, or to missiles striking the valve handle from outside. The Westinghouse Brake Company used in England for years, on passenger cars, air-brake couplings designed to open the valves in the pipes of both cars when the couplings were put together; to close both when separated in the proper manner, and to leave open the valves in both cars when separated violently, as in the case of the accidental parting of a train. Then, as now, the flexible couplings hung, when coupled, U-shape, and the trainman, in uncoupling, pressed upward at the bottom of the U; this upward movement closed the valves. The separation of the cars while in motion pulled the hose coupling apart without lifting, and the valves were so designed that this would leave them open. This device was imperfect, however, and it was finally abandoned. One of its imperfections was that an accidental separation would sometimes lift the coupling, as in normal uncoupling, and thus close the valves and prevent the automatic application of the brakes. In such a situation the rear part of the broken train would run uncontrolled and collision might result. This abandonment was due in part to the real or supposed remoteness of the danger which the invention was designed to provide against.

We have been told by trainmen that handles turned to the wrong position have been discovered when no wreck has resulted, and they attribute this to tramps using the handles as grab irons, and also, perhaps, to tramps riding on the buffer blocks and, in maintaining their unsteady position, putting a foot against the handle and accidentally turning it.

On some passenger cars the safety chains are so placed that, when one of them is not hooked to the adjoining car, it hangs dangerously near where a swing may cause a link to catch and turn the angle-cock handle. It is said, too, that handles have been shaken from their proper position by vibrations of the train-pipe.

The use of a lock to hold the angle-cock handle securely in one position was also early proposed, but it appears that all of the designs were defective in some way, or failed to find favor. No railroad found it practicable to introduce a locked handle in any other way than to put in a new valve; and this was expensive.

A locked handle is now made and has been used on tenders for some time. The Westinghouse Company has delivered thousands of these handles to railroads within the past few months, indicating that they are being put on cars as well as tenders. The design is simple, being practically the same in principle as that of a common type of switchstand. Normally the handle lies flat. Its movement is to the right or left, horizontally, but before being moved horizontally it must be lifted vertically over a

lug. In fitting old cars the valve itself does not need to be renewed, the new design of handle being made to fit the present valve. It would seem to be, in itself, and without a shield, as complete a protection as can practically be made to prevent accidental closing of the train-pipe.

THE STATUS OF THE HOLDING CORPORATION.

Subject to future uncertainties of politics and the attitude of a legislature thus far divided against itself, the state of Massachusetts, through its executive branch, has decided to push through the courts its case against the New York, New Haven & Hartford Railroad Company for alleged violation of the law prohibiting direct or indirect control of street railways by a steam railroad corporation. At the instance of Governor Guild, the Attorney-General of the state has entered an information in the Supreme Court praying for an injunction and, in a kind of supplemental information, asking on technical grounds for a receivership of two of the minor lines taken over by the New Haven company several years ago. The full text of the information is not before us but printed extracts indicate that it raises pretty clearly—or must raise in the course of future proceedings—the legal status of the holding companies, general, local and "voluntary," which have been interposed between the steam company and the controlled trolley lines in Massachusetts. In that comprehensive shape, the suit, coming as it does in a state whose law is apt to be good law, has unique value and suggests some ideas of a broader character on the nature of holding companies and their relations to various important interests.

As related to the carrying of persons and property by rail those companies are of many species. They may be temporary, like a brief voting trust, or permanent and intended as a plan for regular control, or they may be indefinite, to be continued or closed, as conditions suggest. They may be formal chartered bodies subject to fairly close restriction and with defined functions, or, on the other hand, only a kind of "gentlemen's agreement" with a status not essentially different from that of a single big controlling shareholder who naturally agrees with himself. The same diversity appears in the motives for their creation. They may be intended to check speculation or, on the other hand, as a means to promote it. They may be a bar to speculators who seek immediate control of a great railroad property or an instrument of those same speculators, once having gained control, to hold it while releasing their funds for fresh speculation; as Wall street history, and comparatively recent history, attests. They may be, as in the Massachusetts case, a piece of railroad strategy to resist, impair or thwart the operation of a statute. They are both interstate and intrastate, falling, and intended to fall, sometimes under one jurisdiction, sometimes under another. Very often the underlying motive bears directly or indirectly on competition, the New Haven's policy, for an example, having in view future perils of rivalry from long distance electric parallels. The railroad holding company in such a case assimilates itself very nearly in practice and principle to the familiar industrial trust.

In such wide variations of the holding railroad—and railway—companies are naturally to be found elements both good and bad. They are good when, in conservative hands, they protect the shareholder from speculative raids. As representing also the general principle of consolidated management with closer economies, the strengthening of weak subsidiary lines and better public service, they are benign; and even as checks on competition, when competition would otherwise result ultimately in combination with inflated capital, the holding company may have excellent public uses. On the negative side the main evils are irresponsibility to the stockholder and to the public. The stockholder loses direct relation to his property interest and is one degree removed even from the position of a minority shareholder in an ordinary corporation; while, as to the public, the relation to it of the holding corporation is generally loose and ill-defined both by legislatures and courts. This laxity gives rise to anomalous situations, as, for example, enforced returns from controlled corporations while the bigger controlling (holding) body is compelled to make no return at all. This is particularly true of the voluntary or, at least, unchartered holding combinations. On the other hand, when the holding body is chartered, legislative devices for unduly amplifying charter privilege are apt to become too easy; for instance, the old trick of vesting, by a few words, hidden in a verbose charter amendment, the holding corporation with all the powers given originally by a liberal charter to a small subsidiary line. On the whole the public dangers of the holding company have considerably overbalanced its public benefits, which is only another way of stating the corporative truism that indirection is worse than direction.

This brings us back to the prime fact that the railroad holding company, as an organization taking manifold shapes, needs legal outline and definition. Chartered or unchartered, inside the state or interstate, protective or speculative, temporary or permanent, it is a comparatively recent institution, increasing both in number and forms and on which as yet legislation is crude and judicial decisions scant. Hence the special import of the controversy which now seems fairly joined in Massachusetts, covering a wide range of questions, likely to traverse the state courts and, on issues of constitutional rights of voluntary associations, likely to reach federal jurisdiction. Even if the case does not travel that long and sinuous legal path, the preliminary findings of the state tribunals may have far-reaching and original values.

THE WABASH FINANCES.

The capital arrangements of the Wabash Railroad are peculiar. Between the common and preferred stocks and the straight mortgage indebtedness of the road are two issues of so-called debenture bonds; one of $3,500,000 series A bonds, the other of $26,500,000 series B bonds, both bearing a 6 per cent. nominal return. For several years up to January, 1904, the full 6 per cent. was paid on the "A" bonds. Since then no payments have been made on this issue. On the much larger issue of "B" bonds no interest has ever been paid. These issues of debenture bonds, put out at the time of reorganization of a weak property, have been a tremendous handicap to the road. The Wabash is one of the weaker railroads in a highly competitive territory. The strong roads like the Vanderbilt and Pennsylvania lines have been constantly improving their facilities in roadbed, track, motive power, cars and terminals. They have either been free to make new bond issues or, as has more usually been the case, have been able to provide for betterments out of surplus earnings. Meanwhile the Wabash, handicapped at the start, has had difficulty in maintaining its relative position. Not until interest should be regularly paid on the debenture issues was there a possibility of issuing new bonds, while surplus earnings from operation were insufficient for necessary betterments. This stumbling block in the road's progress has within the last year or two, as improvement requirements have broadened, become more and more of an obstacle. Its removal, in a way which should leave the road free to put in force a comprehensive plan of capital expansion, has become steadily more necessary.

The matter was brought to a head by formation in March, 1905, of a committee representing the debenture B bondholders, whose object it was to obtain payment of interest on these bonds, on the ground that surplus earnings applicable to such payment under the terms of the mortgage had been diverted to the improvement of the property. The mortgage covering the "B" bonds is so worded that the holder of the bonds is practically assured of 6 per cent. on his security before any new issue of mortgage bonds is made or any dividends paid on either class of stock. This right, although it stands in some question could, in all probability, be upheld in court. On the other hand, as long as it is insisted upon, there seems little chance that the road will either pay interest on the "B" bonds or hold its own in the keen competition which it must always face. Thus the position of the debenture bondholder is that of a man with the right to insist on a condition, insistence on which is likely to result both in its non-performance and in depreciation in value of his property. A compromise plan has, therefore, been made which is to be presented at the annual meeting of the road next Monday, which provides that the Wabash is to issue $200,000,000 of 4 per cent. consolidated mortgage bonds; each $1,000 of debenture B bonds is to be exchanged for $700, par value of the new mortgage bonds, $500 in preferred stock, now selling at about 45, and $500 in common stock, now selling at about 20.

In the annual report just issued President Delano sums up the present financial situation of the road in the following language, which is interesting also as expressing the opinion of a railroad officer in regard to the present rate situation:

> It seems appropriate to submit to the holders of stock and debenture bonds certain considerations which have been of growing importance to their interests and which seem to the management to be now of controlling importance. Certain definite and settled conditions have resulted from the vast consideration which has been given in this country to the relations between the public and the railroads. Public requirements have become clearly imperative that rates shall be fixed, stable and universal in their

application and that facilities shall be adequate and impartially provided. As a just correlative, however, there seems to be now existing a wider and fairer tolerance of rates remunerative for the service rendered. The management is not apprehensive of serious reduction of the present scale of rates (which in our territory are very low), but it is apprehensive that unless ample provision is made for considerable capital outlays, the company will not be able to fully meet its obligations to the public in furnishing facilities or to gain the greatest measure of profit from the operation of the property. In short, it is believed that the tendency in rates is toward a just, but fixed standard; that the competition of the future will be in the character of services and facilities offered to the public, and that the profits of operation must grow or be reduced and disappear in the measure in which service and facilities are advanced, or suffered to halt and decline.

It must be remembered that the lines of the Wabash traverse a zone of dense traffic, handled on a basis of rates normally so low as to absolutely require ample and perfect facilities for economical operation if operation is to be, and continue to be, profitable. Moreover, this is an era of revolutionized views of what constitutes railroad efficiency, and vast expenditures of capital are being made to conform railroad plants to modern standards. Competing lines, great systems to the north and south of your property, have had the benefit of large and continued capital expenditures while the Wabash, with its debenture mortgage as an obstruction to every important source of new capital, has been seriously handicapped in this respect; restricted, as it has been, to its surplus earnings as its almost exclusive capital fund and with this fund limited in its application by the provisions of the mortgage. The management has not been indifferent to the disappointment from year to year of the expectations of the debenture bondholders, but not only has the application of surplus revenue been necessary in the effort to keep pace with competitors in facilities furnished and to meet the growing demands of the public, but these revenues, conditioned in their use by the terms of the mortgage, have been insufficient to fully meet these needs in the past and are wholly inadequate to enable your company to follow the great strides now being taken by competing systems.

In view of these considerations the management is constrained to urge upon stockholders and debenture mortgage bondholders the importance of the provision made in the plan, now pending for their consideration, to meet immediate and future capital requirements and to enable the company not only to increase the profits of operation but to make these profits distributable. As bonds under the new mortgage will be reserved for retirement of existing liens, equipment obligations and notes, in addition to reservation for exchange of the debenture bonds, the provision through the remaining bonds for the improvement, equipment and extension of the property and for required additions to its terminal and other facilities will be by no means excessive to cover the future requirements of your great and growing property. Owners of the property must appreciate that neglect to furnish needed facilities or equipment not only drives business away to our competitors, but invites hostile legislation and criticism, whereas there is every certainty that money wisely spent in such added facilities will, by the increase in earnings it will bring, render a full return on the investment and in addition greatly enhance the value of the existing property. Indeed, earnings, now some $10,000 per mile, ought, with intelligent expansion of our facilities to be readily increased to even double that figure.

This is a clear statement of the difficulties which the road now faces, and which, in order to make it the property which it should be, must be removed. The annual report, reviewed in another column, shows the favorable results already obtained by the new management. There is also beginning to be felt some benefit from the Pittsburg extension. With the debenture issue out of the way and funds for improvements provided, the next few years could hold a very bright future for the Wabash. The "B" bondholder, therefore, may either hold out for his full 6 per cent., with little likelihood of getting it, at least without a protracted lawsuit; or with faith in the future of the property, abandoning what he may with justice believe to be his rights, join hands with the management in carrying out a plan which will make possible the general up-building of the road. If this shall result, as is natural to suppose, in an increase of earning power, such as that suggested by Mr. Delano, the exchange of debentures for mortgage bonds, preferred and common stock is likely in the end to prove a profitable one.

Report on Salisbury Disaster.*

The report of Major J. W. Pringle, inspector of the British Board of Trade, on the disaster at Salisbury, on the London & South Western, July 2, when 24 passengers were killed, was briefly summarized in the *Railroad Gazette* of October 5, page 292. As before stated, the inspector, as well as the officers of the road, is settled in the conviction that the speed of the train at the time of the derailment was very high, perhaps as high as 72 miles an hour, the descending grade approaching Salisbury being for some of the way as steep as 46 feet to the mile. The train had not only to pass through the 8½ degree curve at which the engine was overturned, but, if it had kept on, would have encountered, a short distance farther on, a cross-over track with reverse curves of 11½ degrees. This at once disproves the theory that the engineman purposed to stretch the speed limit to the highest possible point, expecting to get through by the skin of his teeth. No reader of the testimony can for a moment think that he intended to run through Salisbury at that speed, except on the assumption that he was crazy. The action of the driver is inexplicable. The testimony of men who had seen him before the run was all to the effect that he was sober and in normal physical condition. He was a total abstainer. He had been on duty about 9 hours. He was 40 years old, had been in the company's service 22 years, and a passenger runner between London and Exeter 8 years. This evidence that high speed was unintentional is important, because the engineman had never before run this very fast train, and, it is believed, never before had run a train which had to pass through Salisbury without stopping. An engineman on a difficult run for the first time is likely not only to be abnormally anxious, but to take risks which he would not take under more familiar circumstances; but it is unbelievable that any man could have thought of running through a 11½ degree curve without superelevation at 60 miles an hour.

At the curve where the derailment occurred the outer rail was elevated 3½ inches for most of the way. The sharper curve, which the train would have traversed about 300 feet beyond the point of derailment, was on a cross-over track, and there was, therefore, no superelevation. The train consisted of a 4-4-0 engine, with 6 ft. 7 in. drivers, and weighing 121,000 lbs. The center of the boiler was 8 ft. 6 in. above the track, and the center of gravity of the engine was about 5 ft. above the track. The weight of the five cars in the train, empty, was 113 gross tons, or, loaded, 120 gross tons, estimated.

The special weekly express for the American line steamers was put on in April, 1904. It was scheduled at 50 miles an hour for the first half of the journey (to Templecombe), and 57.9 miles for the last half. Although the time of departure of this train could not be fixed beforehand, a special time table was issued, giving, at the principal stations, the number of minutes from the starting point, and indicating four places where speed must be reduced. After the train had been run a few times an order was issued that nonstopping trains must not pass through Salisbury at a greater speed than 30 miles an hour. On June 14, 1904, a bulletin was issued to the effect that the train must not make up time, and with the addendum, "any driver running at higher than scheduled speed will be taken off his engine." On February 10 of this year a revised time table was issued in which the train was allowed one minute extra as far as Basingstoke for slackening through Salisbury station. Basingstoke is some 30 miles beyond Salisbury. These details are of interest as showing with what care the schedule had to be adjusted to the capacities of the locomotives.

When engines were changed at Templecombe on the fatal night the head guard, who rode in the kitchen van at the tail end of the train, did not test the vacuum brake by reducing the pressure of the vacuum in his gage; but he asserts that he saw the pressure rise in his gage after the new engine was attached, and therefore was satisfied that the brake was in working order. The evidence shows that steam had been shut off when the train passed through Salisbury station, but that the brake had not been applied. The inspector could find no evidence from the condition of the guard rails or sleepers that the engine mounted or jumped the rails, and he concludes that it was overturned by centrifugal force. It had been in service less than a year, and there was no hollowness of tires or sharpness of flanges. Neither were there marks on the flanges of the front truck wheels to show that any obstruction had been struck. All of the axles on the train were found unbroken. The suggestion that the front truck of the engine would not curve is untenable, as the center pin had a clearance of ⅛ inch. With the estimated center of gravity of the engine, a vehicle on this curve would be unstable at about 67 miles an hour, even after allowing for the 3½ inches of superelevation.

Moreover, it is probable that the effect of centrifugal force would have so acted on the springs, whilst the vehicle was still in a state of stable equilibrium, as to bring the center of gravity into the position it would occupy if the vehicle were a rigid body, and there were no superelevation. Unless there is a gradual lead into a sharp curve of this descritpion, the effect of sudden impact has also to be taken into consideration. It is in accordance with the views of well-known writers to make some allowance for effect of impact, in determining the speed at which overturning, due to centrifugal force on a sharp curve, becomes imminent. Some disregard the beneficial effect of superelevation, others make a much greater allowance, by doubling the amount of centrifugal force. In this particular instance, if the small amount of superelevation be not taken into account, a calculation, or diagram of forces, will show that for the engine and tender, taking the centers of gravity as 5 feet and 3¾ feet above rail level, respectively, overturning is imminent on a curve with a radius of 8 chains at speeds of about 63 and 65 miles an hour. * * * Bearing this in mind, and for want of any evidence from the condition of the permanent way, engine wheels, etc., of ordinary derailment, I have come to the conclusion

*Reported in the *Railroad Gazette*, July 6 and 20, General News Section.

that the high speed at which the train was traveling caused the engine to overturn.

The head guard, in the last car, noticed the excessive speed, but was either very slow in discovering it or dilatory in taking action, for the only thing that he did was to apply the vacuum brake lightly after entering Salisbury yard, so as to attract the attention of the engineman. The inspector finds some contradictions between his testimony and that which he gave before the coroner, and concludes that he was little fitted for his responsibility.

Thirty miles an hour, the limit prescribed by the company, is held to be too fast for this curve. While it may be slow enough for safety, if the maximum superelevation is provided in the outer rail of the curve, it is not slow enough for the comfort of passengers, and this last is an element to be considered. In view of the presence of the cross-over track the inspector thinks that 15 miles an hour is the highest allowable speed. In a foot-note he suggests the further consideration that the distant signals at both ends of the yard should be held at danger against trains, with the object of emphasizing the speed limits.

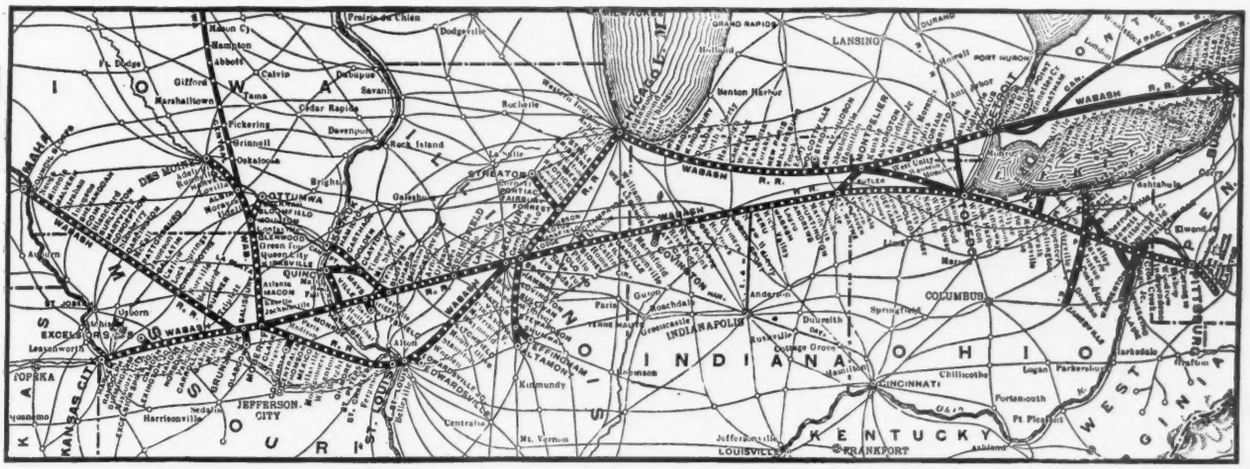
Some of the passengers were not promptly released from the wreck, and it has been suggested that there were not enough saws and other cutting tools available. But an inspector arrived at the scene of the accident within 20 minutes, bringing three adzes, three hand saws, two cross-cut saws and one axe, so that no criticism is offered on this point. The inspector concludes with the remark that there is "no other known case in the United Kingdom where overturning has been caused by high speed," and that in the last 17 years only two passengers have been killed in train acidents on the London & South Western.

Wabash.

The last fiscal year is the first during which the present management of the Wabash has been in control. Many changes have been made. The engineering and maintenance of way departments have been reorganized; the locomotive and car departments consolidated; the fuel and store departments converted into a supply department, with jurisdiction over fuel, supplies, stationery and material; the President Delano's remarks about the limitation of necessary future improvements by the present outstanding issue of debenture bonds are quoted and discussed in the editorial columns.

The report is divided into four parts instead of two, as in previous years. These are signed, respectively, by the president, the general manager, the traffic manager and the fourth vice-president in charge of the accounting department. In order not to limit the comparison with the abnormal year ended June 30, 1905, which was greatly affected by the St. Louis Exposition, figures are also included in the report for the year ended June 30, 1904, which would naturally furnish a fairer comparison. There was naturally a large decrease in passenger earnings, as compared with the World's Fair year, but this was a little more than made up by freight earnings, which increased more than 18 per cent. In 1905 passenger earnings made up 36 per cent. of the total, against 27 per cent. last year. The opening of new rail lines between Chicago and St. Louis (Chicago & Eastern Illinois) and between St. Louis and Kansas City (the St. Louis, Kansas City & Colorado line of the Rock Island), the competition of electric lines in Illinois and Indiana and the recent two-cent fare law in Ohio are mentioned as further causes of the loss in passenger earnings. While gross earnings show an increase of only $318,779 over 1905 the fact that there were large decreases in the three important expense accounts is responsible for the gain of $2,744,336 in net earnings, which is at the rate of over $1,000 a mile. Maintenance of way expense decreased $898,000, maintenance of equipment $895,000, and conducting transportation $626,000, the latter increase being due to a much larger train load and the taking off of the fast World's Fair passenger trains, which besides being operated at an extremely small margin of profit greatly impeded operation of the freight traffic.

The unit maintenance costs were $983 per mile for straight maintenance of way, against $1,360 in 1905, and $1,141 in 1904. Maintenance of way, including additions and improvements, cost $1,235 per mile, against $1,592 in 1905, and $1,463 in 1904. Exclusive of payments for new equipment, straight maintenance of equipment cost $2,937 per locomotive, against $2,790 in 1905; $597 per passenger car, against $884 in 1905, and $50 per freight car, against $78 in 1905, this last abnormally high figure being due to the repairing of freight cars by an outside company, already mentioned.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Rochelle
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Davenport
Grinnell
Rock Island
Oskaloosa
Bright
Galesburg
OTTUMWA
Albia
Centerville
Princeton
Chillicothe
Utica
Trenton
Unionville
Milan
Green City
Queen City
Memphis
Kirksville
Atlanta
MACON
Paris
Monroe City
Quincy
Hannibal
Palmyra
Clarence
Shelbina
Mexico
Auburn
St. Joseph
Bethany
Cameron
Excelsior Springs
Lexington
Lawson
Harlem
Plattsburg
Osborn
Maysville
Stewartsville
Cameron
Winston
Gallatin
Jamesport
Trenton
Prince

Denver & Rio Grande.

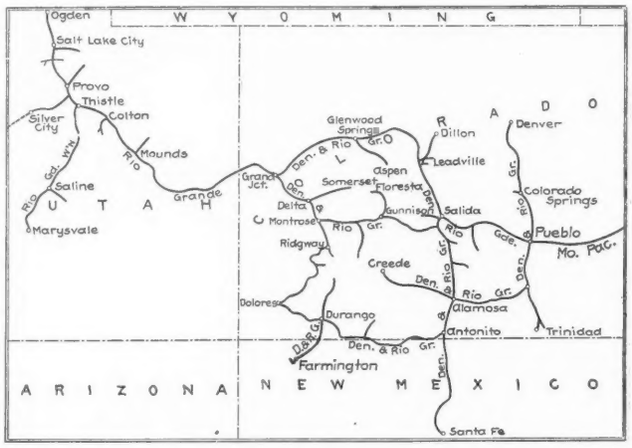
The year has been a prosperous one for this Colorado road, with an increase of $2,654,607 in gross earnings and $719,393 in net earnings, gains of 16 and 10 per cent. respectively. Accordingly, after the regular dividend payments on the preferred stock, there was an appropriation of $1,150,000 for betterments—$1,000,000 for additional standard gage equipment and $150,000 as part cost of new engine-house at Denver and Pueblo—against a like sum of only $283,915 charged against current account in 1905. The gain in gross earnings was evenly distributed between freight and passenger traffic, as freight earnings increased over $2,000,000 and passenger earnings $570,000. The gain in net earnings was not the result of skimping the maintenance account, as there were increases in every item of unit maintenance. Maintenance of way per mile was $975, against $826 in 1905; maintenance of equipment per locomotive was $2,277, against $1,970 in 1905; $607 per passenger car, against $466 in 1905, and $57 per freight car, against $44 in 1905. An increase of over 200 per cent. in the cost of rail renewals is one instance in which expenses under the ordinary operating accounts are working for the betterment of the road. The largest proportionate increase under maintenance of equipment is in repairs and renewals of baggage, mail and express cars, which increased over 100 per cent. Cost of conducting transportation rose 17½ per cent., a fairly normal increase, corresponding with the increase of 21 per cent. in revenue ton miles. The item injuries to persons under this head increased for the year by $68,000, or 58 per cent., probably as a result of the disastrous collision at Adobe, Colo., on March 16 of this year.

Like the Colorado & Southern, the Denver & Rio Grande gives statistics for both tonnage and revenue of classified freight traffic. Bituminous coal furnished 32 per cent. of the tonnage and 20 per cent. of the revenue; precious ore, 25 per cent. of the tonnage and 16 per cent. of the revenue; manufactures made up 6 per cent. of the tonnage and furnished 12 per cent. of the revenue, and miscellaneous and general merchandise, 4 per cent. of the tonnage and 18 per cent. of the revenue. The Denver & Rio Grande evidently does not obtain so high a rate on lumber, for this item of traffic furnished 3 per cent. of the tonnage and 4 per cent. of the revenue, while on the Colorado & Southern lumber made up 2 per cent. of the tonnage and furnished a much larger proportion, 7 per cent., of the revenue. The train load increased from 207 tons in 1905 to 220 tons last year, or including company freight, from 236 tons to 252 tons. The average receipts per ton-mile were 1.29 cents, against 1.34 cents in 1905. This is a high ton-mile rate and is largely responsible for the present prosperity of the road. The passenger mile rate also decreased, from 1.91 cents in 1905 to 1.81 cents last year.

Extensions and improvements during the year include the construction of a 28-mile extension of the Bingham branch to reach extensive smelting plants on the south shore of the Great Salt Lake, about 15 miles west of Salt Lake City, Utah, 12 miles of the extension being made necessary by the fact that the existing line into the Bingham mining district, known as the Copper Belt Railroad, has such steep grades as to make it impossible to carry the daily tonnage which the mines produce and the new smelters will require. There were 16 miles completed on these extensions during the year, as well as a 4-mile branch from Roy Station near Ogden to Hooper. Since the close of the fiscal year the western portion of the main line of the third division between Montrose, Colo., in the Uncompaghre Valley, was changed from narrow to standard gage. The work of laying 80-lb. rail on the main line between Denver and Grand Junction was completed. On the main line west of Grand Junction 77½ miles of this weight of rail were laid, making about 127 miles on the western section laid with 85-lb. rail. Of the remaining 200 miles, 143 miles are laid with 75-lb. rail and about 58 miles are still to be laid with the heavier section. The engine-houses which have been in use at Denver and Pueblo were originally designed for narrow gage motive power. They were found to be inadequate and the construction of new engine-houses is now under way. The one at Denver is nearly finished. The larger engine-house at Pueblo is to be a 49-stall brick building, with concrete cinder pits, a 600-ton capacity coaling station and an 80-ft. electric turntable.

In regard to the Western Pacific, which is to be the Denver & Rio Grande's Pacific connection, it is stated that scarcity of labor has retarded the work and the amount accomplished thus far is less than was anticipated. The financial details, unfinished a year ago, were concluded by increasing from $50,000,000 to $75,000,000 the capital stock of the Western Pacific, under which arrangement the Denver & Rio Grande and its subsidiary Rio Grande Western Company, hold $50,000,000, or two-thirds of the capital stock in their treasury.

The report continues, "Recent events in San Francisco have in nowise disturbed the confidence your directors have expressed in this new line of railroad and in the advantage to be derived from development of its local resources and its importance and value to the Denver & Rio Grande. Faith in the future of the Western Pacific is just as strong as it was before the San Francisco disaster. The city will be rebuilt on finer, more attractive and better engineering plans. The great harbor will continue to hold and increase its ocean commerce. The navigable streams of the Sacramento Valley will always attract and sustain inland navigation. San Francisco as a financial center will maintain her supremacy on the Pacific coast. Trade and commerce by land and water will pay tribute in greater volume than ever before to her merchants, manufacturers and



Denver & Rio Grande.

citizens. The soil of California is as fertile as before the disaster, the mines as productive, the forests as rich in timber, and the other natural resources just as extensive and valuable."

The principal operating results, with comparison with the preceding year, are as follows:

	1906.	1905.
Mileage worked	2,477	2,420
Freight earnings	$13,943,556	$11,932,420
Passenger earnings	4,609,428	4,039,418
Gross earnings	19,686,115	17,031,507
Maint. way and structures	2,415,353	1,998,494
Maint. of equipment	2,566,411	2,031,523
Conducting transportation.	6,621,986	5,632,606
Operating expenses	12,104,172	10,168,961
Net earnings	7,581,943	6,862,547
Net income	3,712,474	2,932,452

NEW PUBLICATIONS.

The San Francisco Earthquake and Fire. By A. L. A. Himmelwright, M. Am. Soc. C. E. New York: The Roebling Construction Co. 9⅜x11 in.; 270 pages; 173 illustrations. Price, $5.

A brief history of the San Francisco disaster, a presentation of facts and resulting phenomena, with special reference to the efficiency of building materials, and the lessons to be drawn from the effects of the disaster in this respect, are given by Mr. Himmelwright in this work. The author made a personal inspection and detailed examination of every building of fireproof construction in the burned district. There are 74 such buildings included in the report, and the effect of the fire on several non-fireproof buildings is also discussed. These included the Palace Hotel and four or five other buildings having brick walls and floors and roofs of combustible material. Each building is covered individually in the report, the name, location, architect and owner being given, followed by details of construction, effects of the fire and earthquake, and such brief comments as the latter suggest regarding the general condition of the structure and the conclusions to be drawn therefrom. The engravings illustrating these effects are practically all full-page half-tones from photographs which were carefully taken and are excellent in detail. These engravings present a most interesting and instructive series of studies and form a valuable record in the history of fireproof building construction. The general comments and conclusions of the author resulting from his investigation, filling 23 pages, follow the individual exhibits and discuss the character of different types of construction and the efficiency of the various kinds of building materials. In this presentation he endeavors (1) to point out those methods and details of building construction which developed good efficiency in the fire; (2) to call attention to those features of construction which were either defective or failed to fulfill the requirements; and (3) to note important omissions in designs. The volume concludes with 12 lessons to be drawn from the fire and six from the earthquake, all presented in concise form.

Proceedings of the American Railway Master Mechanics' Association. 1906. Chicago: Published by the Association. Half leather, 6 in. x 9 in.; 570 pages.

The report of the thirty-ninth annual convention of the American Railway Master Mechanics' Association held at Atlantic City, N. J., June 18 to 20, 1906, is the largest volume yet published by the

Association, indicating the growth of the scope of its work and the interest taken in the discussions of reports and papers by the members. Among the subjects of committee reports included in the volume are tire shrinkage and design of wheel centers, flexible staybolts, water softening, locomotive tests at St. Louis, front ends, classification of locomotive repairs and specifications for cast-iron. A number of individual papers are also printed, including special valve gears for locomotives, superheated steam, welding locomotive frames, injectors and fire kindling. These papers and committee reports are, if anything, above the high standard of previous years, and contain information and data to be found in no other publication. As in previous editions, the standards of the Association are shown on folded sheets inserted in the back of the book, and a good index to the contents of the reading pages is also included.

Index of Papers and Subjects Discussed by Railway Clubs. Published by the Society of Railway Club Secretaries. 23 pages, 3 in. x 6 in.

The list of the subjects presented at the railroad clubs in the United States at meetings from May 31, 1905, to May 31, 1906, is now being distributed. The pamphlet begins with a brief history of the work and growth of these organizations, the first of which, the Master Car Builders' Club, was formed in 1871, the name being changed in 1887 to the New York Railroad Club. The Society of Railway Club Secretaries was organized in 1896 to systematize and simplify the work of the various associations.

Consolidation Type Freight Locomotives. 72 pages, 6 in. x 9 in. Published by the American Locomotive Co., 111 Broadway, New York.

This is the latest of a series of pamphlets devoted to types of locomotives built by the American Locomotive Co. The locomotives described are those weighing less than 175 lbs. There are four pages of tables giving the principal dimensions of 30 locomotives, and the rest of the pamphlet is taken up with more extended illustrated descriptions of these engines. This publication is the third of a series, the first two describing Atlantic and Pacific type locomotives.

Recent Interstate Commerce Commission Rulings.

The Interstate Commerce Commission has announced the following rulings: A copy of an arrangement between common carriers governing joint rates between them on interstate business must be filed with the Commission. When such an arrangement is verbal or is contained in correspondence between the parties, or is a part of their custom and practice, a memorandum of its terms must be filed with the Commission.

The recent notice to the effect that a joint rate on a given route higher between any points than some of the local rates between the same points by the same route may be reduced to the sum of such local rates until December 31, 1906, upon posting the reduced rate one day in advance and mailing a copy to the Commission has been amended to apply to the joint rate in effect by a given route higher between any points than the sum of the locals between the same points by the same or another route.

Rates for a series of excursions limited to either a period of not more than three days or to a period of more than three days and not more than 30 days may be established upon notice of three days as to the entire series, and separate notice of the excursions on each day covered by the series need not be given. Round trip tickets on the certificate plan may be issued at reduced rates and their use confined to delegates to a particular convention or members of a particular association on condition that a certain number of such tickets be presented for validation before the reduced rate for the return trip be granted to any holders. The notice regarding these tickets must be regularly filed and posted; such tickets may also be issued to government employees going home to vote and returning to their employment. The Commission suggests that not less than 100 tickets be presented for validation before the reduced rate be granted to any. Free transportation may be granted to only such employees of carriers as are actually in the service of a carrier and use substantially all their time in the work or business of such carriers. However, a carrier may give the necessary free transportation to a person traveling over its line solely for the purpose of attending to the business of or performing the duty imposed upon a carrier, and a carrier may transport free household and personal effects of an employee, who has to remove from one place to another at the instance of or in the interest of the carrier by which he is employed. Free transportation or reduced rates may be given to contractors for material, supplies and men for use in the work on the line of the carrier, but such arrangements must be made a part of the specification of the contract. Members of the family of clergymen are not entitled to free transportation or reduced rates. Officers of the government, the army or the navy cannot be given transportation or reduced rates. Whenever by special permission of the Commission the tariff is made effective in less than 30 days, such tariff must bear notice that it is issued by such special permission.

Ways and Means to Maintain Car Supply.*

BY L. C. BIHLER.

There are opportunities for bettering ways and means to maintain car supply both on the industrial and the railroad side, which will assist in preventing shortages of cars. For one thing, deliberate and premeditated overshipment on the part of certain shippers in supplying raw material to customers in their eagerness to forward all they can, if they have permission to ship all they can produce, should not be encouraged or tolerated. There are conditions, however, which, from the standpoint of the receiver, make it necessary for practical operation to have perhaps larger shipments on one day than can be unloaded; for instance, in the case of holidays or an actual strike in sight, which might affect supply; and the same conditions might govern also as regards a stock of material for current consumption. Too often, by far, is the overshipment of certain classes of material by certain shippers tolerated by railroads. In fact, there have been some cases where it has been deliberately helped along by the railroads themselves, and the available car supply has been given largely to the people who have overshipped.

If a commodity like coal was subject to the same vigorous treatment as other commodities and a system devised whereby, at tidewater or at Lake Erie ports, it could be unloaded over trestles and the steamer loaded from the supply under the trestles, car supply for ore and limestone could be largely increased and maintained. It is only necessary to refer briefly to the fact that each coal carrier has anywhere from 20 to 50 or more shippers on his line, each shipping a few cars a day, each of three or four sizes coal, to Lake Erie ports or tidewater, all of which are detained at the water front until the quantity of a cargo of each grade is reached and loading of vessel begun, before the first cars are released. In no other line of traffic is this tolerated. This, therefore, is one of the most important questions whereby the railroads and the coal shippers, in working together for a common purpose, can accomplish some good in radically increasing and maintaining the supply of cars.

Another feature which might be touched upon is the practice of some shippers in loading a partially completed order in a car and detaining the car until the remainder of the order is manufactured, all of which is, of course, wrong, and if abandoned by all shippers, will also assist in increasing the available supply of cars for full loads, waiting either at the plant or elsewhere.

The question of prompt repair to crippled equipment is also deserving of the closest attention on the part of railroads at all times, since it is a matter of common knowledge that hundreds of cars are frequently standing on sidings awaiting opportunity to get into the repair shops, when, as a matter of fact, perhaps more than half of the cars, requiring light repairs only, could be repaired where they stand, if traveling gangs of car repairmen were maintained. It is surely possible, without a great deal of expense, to have slightly crippled cars repaired where they stand, leaving the others to take their turn to get into the shops, and in busy times to send to the shops only those cars that cannot be treated outside the shop. We might also briefly touch on the point of maintaining in proper and safe condition freight car equipment and motive power at periods when general business is dull, when it can be done at less expense to the railroads. It is a matter of record and repeated fact that, during dull periods, the condition of equipment and power of many railroads is permitted to run down, defects are not remedied, and the effort to always be in shape for any increase in business that comes along, is not made until after the increase in business has arrived, when the matter of repairs is more difficult of performance because of the busy conditions of all branches of labor which comes with an increase of business. "In time of peace, prepare for war," might here be applied, by preparing in times of dulness to have the maximum amount of equipment ready for service when required.

There have been times in the past when restrictive or prohibitive loading rules were created by the Master Car Builders or the motive power departments of railroads, which have been without due regard, in some instances, for the rights of shippers, or without full and free consultation with the traffic and operating departments, in so far as these M. C. B. rules affected directly or indirectly the maximum load limit, which, if small, particularly of double or triple length or overhang material, increases the given number of cars required to carry a certain tonnage. Any reasonable shipper will always be willing to regard safety first, but he hesitates at arbitrary decisions of one department of a railroad which are "iron-clad," when these carry with them the imposition of additional costs for securing loads, a maximum quantity that may be loaded, and make it necessary to have more cars to carry a given tonnage, increasing the demand of a shipper for equipment at times when liberal, reasonable and safe rules do not always absolutely require it. In other words, there is opportunity for practical co-operation between shippers and motive power, mechanical,

*A paper read before the Traffic Club of Pittsburg.

car building, operating and traffic departments of railroads.

It is also desirable that the division superintendents, car distributors and trainmasters always keep in close touch with all the shippers along their divisions, in order to know what kind of cars they can use for their material. For instance, a shipper of brick or sewer pipe can, as a rule, use a box or gondola car, and it is not, to my mind, good railroad practice if the railroads, as they frequently do, carelessly give him the first cars of either kind they can lay their hands on, when some other shipper who needs a gondola car and cannot use a box car, is deprived of the gondola by reason of its having gone to the brick shipper, and a box car, conveniently handy, which could have gone to the brick shipper, is standing idle because the brick shipper has his gondola, and the shipper who wants the gondola, cannot use a box car. The same remarks would apply to coal shippers who can load either gondola or hoppers; likewise to sand shippers. Cases of this kind have been known to happen frequently, but they need not have happened if the car distributor had sufficiently informed himself as to his shippers' needs. By care in this respect a better supply of cars is surely available.

Another important point is in regard to the negligent or careless waste of car capacity, something that may be corrected by full co-operation by the railroads and the shipper. It frequently happens that shippers will ask for a large capacity car when a smaller one will answer for the shipment at hand, and surplus capacity which some one else would be anxious and glad to have is wasted. On the other hand, there have been many cases where, when a shipper has ordered a smaller sized car, he has been given a large capacity car, because it was more convenient to place it than another, although smaller capacity cars have been available and some other person who wanted a large capacity car is, perhaps, deprived of it because of careless division of available equipment, the practical result being deficiency in carrying capacity.

The question of prompt unloading of inbound material, in order to create car supply for outbound, has been so fully discussed that it needs no particular reference at this time. The division of certain kinds of equipment as between the railroad company for their own fuel and ballast needs, and shippers, also has an important effect on car supply. The railroads invariably place and select for their own uses the character of equipment most suitable for them and most economical to unload, and then out of what is left, they make the division, frequently forcing additional expense on the consignee. For instance, in case of limestone, coal, etc., which mill operating conditions generally require should be received in hoppers or drop bottom cars for unloading over a trestle, too frequently solid floor gondolas are furnished, the railroads using the available hoppers for their own company material, and the extra cost of shoveling over the sides of a high gondola loaded with sand, limestone, dolomite, ore and similar material, is imposed on the consignees. The extra time consumed in unloading undesirable equipment not only restricts production, as raw material can frequently be consumed faster than it can be unloaded from unsatisfactory cars, but also adds to car detention. Any extra cost in unloading operations should not be borne entirely by the shipper or consignee.

As to the proper kind of equipment for the several classes of open car freight, which move in extraordinarily large volumes, it seems probable that a universal gondola-hopper car or composite car will be the car of the future. Several years ago, one of the large systems provided a large number of gondola cars, with sides 30 in. high, steel underframe and drop ends, cars being about 37 ft. 8 in. long inside. This innovation was hailed with delight, because of the belief by iron and steel shippers that something had been done in their behalf, by providing something that had never before been attempted, namely, a car peculiarly adapted to carry iron and steel of long lengths, without incurring the maximum cost for blocking such long pieces, as customers require and the tendency of the trade of later years demands. Bridge sections, girders and like material are now demanded by buyers in longer sections than before, all of which had made the long car with drop ends particularly valuable for the shipment of such material. It was not long, however, before this pattern of car became scattered all over the country, because of the large volume of traffic moving from the iron and steel district in all directions, and these cars drifted and continue to drift, notwithstanding efforts to the contrary, into coal, sand, brick, lumber, stone and other trade, until now, what was formerly a large supply of suitable cars for long lengths of iron and steel, has dwindled to a comparatively small available supply. This character of solid floor equipment has gone into the iron ore and limestone trade, and in time of extreme stress and emergency, consignees are willing to accept the material loaded in this class of equipment, rather than be forced to go without it, notwithstanding the large expense of handling the load over the side as compared with unloading through a car dumper or over a trestle.

It will probably never be possible or practicable to entirely limit the use of special equipment to the particular class of trade for which it was designed and is peculiarly adapted, consequently the suggestion of a composite or universal gondola-hopper car for all that class of traffic which has to move in open cars seems reasonable. The special equipment to which reference has been made is not always capable of carrying the weight capacity indicated; for instance, a car will carry 100,000 lbs. of steel or ore, but would only carry perhaps 60,000 lbs. of coal, and there is, therefore, probably 40,000 lbs. of weight capacity wasted. The same car also is so long that it does not go through some of the car dumpers used in connection with blast furnace plants. Apparently, the capacity and length of a car dumper was perhaps not given sufficiently thorough consideration by both railroad and manufacturing interests at the time the railroads adopted this long car. In adopting a universal car, the opinions of the shipper, receiver and carrier must be taken into consideration. One of the roads in this district (Pittsburg) has recently taken a step in undertaking to provide a car which goes towards filling the bill for universal gondolas. Several thousand new cars have been bought covering some of the good points of the modern open car, but not all of them. The length of the car in question is 41 ft. inside, capacity 100,000 lbs., height of sides 50 in. This car was designed in the belief that less weight capacity would be wasted, and therefore the maximum use of equipment and a more far-reaching maintenance of supply would be gained by its use. It is figured that a car of the dimensions indicated will carry the full weight of coal, to the extent of its marked capacity, and will also serve for iron, ore, coke, limestone, sand, brick, ordinary length steel, pipe, lumber, clay or any other open car commodity. This car, however, without drop ends or drop doors, or hoppers, is less valuable than a universal car that is provided with hoppers and drop endgates. For extra length pieces of iron or steel extending over two or more cars, the load will have to be superimposed, at extra cost to shipper for blocking, and M. C. B. rules would restrict loading limit, thus wasting capacity.

The modern freight car of to-day is a car built wholly of steel or with steel underframe, insuring maximum safety to property and life, with a minimum of cost for maintenance and repairs. One of the large systems of the country has served notice that on and after Jan. 1, 1907, they will not accept for transportation any cars not up to their standard of construction. A second large system, which recently intended to place an order for 20,000 or more freight cars, having in mind steel or partial steel construction, were so late in placing the orders that in order to get the equipment at all, they had to take a wooden car. Since then, however, information received is to the effect that half of the order for wooden cars has been canceled, principally with the idea in mind of securing a more durable car. Within a few years the time will be here when the large systems of the country will all refuse to handle cars unless up to modern standard of construction as to suitability, safety, etc., and it is not unreasonable to assume that national legislation may be created and enforced, requiring at least certain standards of construction. The modern steel car costs considerably more than a wooden car, but its life is very much greater; therefore, when considering the purchase of new equipment and the desirability of its being of a modern standard of construction, new equipment should be designed as far as possible with the idea of taking care of the greatest possible variety of different kinds of loads offered, thus going a long way towards the question of maintenance of a supply of freight car equipment.

In 1905, railroads of the United States placed orders for about 350,000 freight cars, two years' work for all the combined car shops of the country. It would be interesting to know, of these 350,000 cars, how many were based on designs planned after full and free consultation with the traffic departments of the railroads. With the idea of furnishing cars that could handle the greatest possible variety of loads, the traffic departments of the railroads have the means at hand of canvassing the shippers and receivers to learn what classes of freight they have in large volumes and what kinds of cars are best adapted to move it. It would be equally interesting to know how many Master Car Builders, motive power, mechanical engineering and operating departments of the roads, who ordered or planned this large lot of equipment, consulted the traffic departments or shippers or receivers for ideas as to universal cars. Is there not room here for the best kind of co-operation between the traffic departments of industrial concerns and the various departments of the railroads?

If the carriers of the country will take advance steps to meet the legitimate needs of the growing traffic of this great country and place themselves beyond just criticism of the public, we shall hear less of that class of railroad legislation which threatens to penalize the railroads if they do not deliver empty cars ordered for shipment within a given number of hours.

It is figured that there is a deficiency in freight car equipment in the country to-day of over 200,000 freight cars. The estimated tonnage of the greater Pittsburg district for the year 1905 was in the neighborhood of 100,000,000 tons, which is an increase of some 132 per cent. over the figures for 1897, a period of eight years, yet who will venture to say that the transportation lines have increased

the supply of equipment nearly as much in the same length of time. Incidental to all this is the all-important question of sufficient motive power available at all times to keep cars moving. It has been suggested that perhaps there are too many freight classification yards at division terminals, and that once a road engine is hooked onto a train, the road movement is fairly good, but that the effect of the good movement on the road is largely nullified by the exceedingly great delays to which a car is subjected in the classification yards. There seems to be no particularly good reason why through freight at least should not be handled with the same degree of despatch at division terminals as through passenger trains.

One of the underlying principles of the entire subject is practical co-operation by all parties. In an address delivered before the club some months since by Mr. H. W. Thornton on the subject of "Co-operation" (*Railroad Gazette*, August 31, pages 170 and 182), some of these features were touched upon in a somewhat different way, and in an address delivered also before this club some seven or eight months since by Mr. J. B. Yohe, a statement was made that if loading and unloading by shippers or consignees could be speeded, it would mean an increase in available number of cars. It is also pertinent to remark that if the mileage per hour of freight trains were increased and some of the delays at yards and division ends cut out or reduced, it would also increase the available quantity of equipment. Equipment is practically valueless without sufficient motive power in first class condition with which to promptly move it; consequently, the question of motive power is a prime factor in the entire question of maintenance of supply of equipment. Meantime, until some better condition is reached, if there is more general and actual co-operation between the railroads, the shippers and the consignees, an improvement in existing conditions is surely bound to come.

Railway Signal Association Reports.

The annual meeting of the Railway Signal Association was held in Washington, D. C., Oct. 16-18. Below are given extracts from some of the committee reports presented:

INSTALLATION AND MAINTENANCE OF STORAGE BATTERIES.

At the January meeting this committee made a preliminary report. On June 15 a list of questions was sent out, but only 20 replies were received, and information was given by only 10. The committee does not feel justified, considering the small number of replies received as compared to the storage battery installations, in making other than the following recommendations at this time.

Construction of Cells.—Storage cells for railroad signaling should have the grids made of one piece to prevent possible resistance, due to contact losses. The formation should be of the Plante type.

Separators of rubber for portable, and rubber or glass for stationary cells should be used.

Covers should be used to prevent loss of electrolyte due to spray and to keep out foreign matter. They should not be sealed.

Portable cells should have splash proof covers with gas vent. Jars should be rubber, placed in suitable wooden cases.

Stationary cells should have glass jars in sand trays on insulating supports to distribute the weight and prevent current losses due to grounds.

Stationary cells should be placed in a ventilated shelter that is acid proof. A coating of acid-proof paint will assist in making it impervious to acid fumes.

The fumes should be kept away from all signal apparatus.

Damage to bright metal instruments and connections can be prevented by a coating of vaseline.

Protection from cold temperatures is not necessary.

Electrolyte, when prepared, should be made of chemically pure sulphuric acid and distilled water.

Electrolyte should be obtained from manufacturers when possible.

Impurities in the electrolyte will lower the capacity of the cell.

Installation, Transmission Line System.—The transmission lines should be equipped with lightning arresters, and can be put on poles with telegraph wires, and carry 500 volts.

They should go from line to batteries through air when possible.

The same wires can be used for charging batteries for motor signals and track circuits.

Duplicate sets of batteries should be used.

Only one long track circuit should be supplied from one set of cells.

The cells should have a reserve capacity to give five days service after interruption of supply.

Portable System.—The cells should have a capacity to run the signal 30 days with a reserve supply of from 25 per cent. to 50 per cent. at the end of that time.

There should be about 25 per cent. more sets than there are signals.

Sets of storage cells should be shipped between signals and power house by freight and motor car or by motor car alone.

This system is giving entire satisfaction on single track roads in the west for motor signal circuits.

Gravity Battery Storage System.—Gravity cells in this system do not require any special attention provided connections are good.

The number of gravity cells should be such that the charging e.m.f. and the counter e.m.f. will adjust themselves automatically.

This system is giving good satisfaction where used.

Maintenance.—Storage cells used in signal work should be examined once a week, by making voltage and specific gravity test, and inspecting for short circuits.

If the electrolyte is kept free from impurities and the plates free from short circuits, the cells will hold up under severe conditions.

The specific gravity of the electrolyte must never be adjusted until the cause of the disarrangement is found and removed.

A pilot cell is not advisable in small sets such as are used in signaling.

An overcharge once a month will keep the cells in good working state under ordinary conditions.

Tests of Electrolyte for Impurities.

Platinum.—Pour the electrolyte into a cell in which the regular battery plates are immersed. If gassing takes place for some time on open circuit, the presence of platinum is indicated and a test by a skilled chemist should be made as the smallest trace will discharge the cell.

Iron.—To half a test tube of electrolyte add a few drops of chemically pure nitric acid, HNO_3, boil and when cool to half of this add a few drops of potassium-sulphocyanide, KCNS. A deep red color will show the presence of iron. To the other half add ammonia in excess and set aside to cool. A brown precipitation shows iron present in dangerous quantity.

Chlorine.—Dilute electrolyte with five or six volumes of water and add a few drops of nitrate of silver, A_gNO_3. A cloudy white precipitate, turning blue in sun light, indicates chlorine.

Nitrates.—Put 25 cu. cms. electrolyte in a test tube and add 10 grams of strong ferrous sulphate solution; carefully pour down the side of the test tube 10 cubic centimeters of chemically pure concentrated sulphuric acid. If nitric acid be present it will be indicated by a stratum of brown color which will form between the solution and the concentrated acid. The depth of color will indicate the relative proportion of nitric acid present.

Copper.—To a sample of electrolyte add an excess of ammonia hydrate. A rich blue color indicates the presence of copper. Or, to a sample of electrolyte add potassium hydrate. If a blue precipitate is found which turns black upon boiling, it is an indication of copper.

Mercury.—The presence of mercury in the electrolyte is indicated by a black precipitate when lime water is added, or by an olive green precipitate when potassium iodide is added.

M. E. Smith, G. B. Gray, W. J. Eck, J. E. Hackman, I. S. Raymer, Chairman.

HOW TO REMEDY THE EFFECTS OF FOREIGN CURRENT ON AUTOMATIC BLOCK SIGNALS.

Under "methods of protection" against foreign current interfering with the working of automatic signals, the committee submit the following conclusions for adoption by the Association:

1. When there is a crossing of an electric road with a steam road, batteries must be placed at each end of steam road track next to crossing and battery current arranged to flow in direction with foreign current leading into track circuit, if foreign current is found to flow in a definite direction. The connections, through block section for control of signals, must be made by means of line wire circuits. If there is sufficient foreign current to improperly work the track relay when an insulated joint is broken down, the multiple track relay arrangement should be used.

2. For situations where there are power houses and foreign currents follow the track rails, although there may not be a crossing or connection with an electric road, it is recommended that the conditions be carefully studied and exact information obtained as to the source, direction, amount and pressure of foreign current and provision should then be made for removing or blocking out this current.

3. To minimize as far as possible the effects of foreign current on line wire circuits, it is regarded as important that trunking be kept above the top of the ground, the rubber and other insulations be kept in first-class condition and the common wire limited to a length of ten miles.

4. For multiple arrangement of track circuit relays, a resistance of 16 ohms is suggested for relay at battery end and 4 ohms for the relay at the other end of track circuit. The committee recommends that further research be made to establish the proper re-

lation of the resistance, pick up and releasing point of the two relays of the multiple track circuit arrangement.

5. For track circuits having but one relay, a resistance of 9 ohms is recommended for circuits 500 feet and under, and a resistance of 4 ohms for circuits of greater length than 500 ft. While it is recognized that the best results are to be obtained by using a relay having a resistance proportioned to the resistance of the circuit, the benefits do not compensate for the disadvantage, from a maintenance standpoint, of having to keep in stock track relays of a number of different resistances.

6. It is advisable to thickly coat with a heavy oil the parts of an insulated joint before the joint is put in place. If there is interference from foreign current it is advisable to put a heavy oil on the joint and particularly around the exposed ends of the fiber at least every two months.

7. For direct current track circuit connections run in trunking, No. 8 or larger B. S. gage soft drawn copper wire with $^{3}/_{32}$ in. rubber insulation wall is recommended.

8. For signal circuit connections run in trunking a No. 12 or larger B. & S. gage, soft drawn copper wire with $^{5}/_{64}$ in. rubber insulation wall is recommended.

9. Trunking when run parallel with the track should be kept clear of the ground. When run across tracks, trunking should be put in with top clear of the ballast and with top of capping not less than ½ in. below bottom of rail.

10. The standard ground should be made by burying in moist earth an annealed copper plate $^{1}/_{16}$ in. thick, two feet square, to which has been brazed for a length of 12 in., a No. 4 B. & S. gage soft drawn bare copper wire. The plate to be buried in clay or in a six-inch layer of fine charcoal and the connecting wire is not to exceed 150 feet in length. The effectiveness of the ground should be tested by a Wheatstone bridge.

W. H. Elliott, Chairman; C. C. Anthony, Azel Ames, Jr., C. C. Rosenberg.

SPECIFICATIONS FOR RUBBER INSULATED SIGNAL WIRE 600 VOLTS OR LESS.

The committee has not yet gone fully into the matter of stranded conductors or cables, either aerial or submarine, but submits a specification for rubber covered wires covering solid conductors of sizes Nos. 0, 1, 2, 4, 6, 8, 9, 10, 12, 14, 16 and 18. A conference was held in New York with Messrs. LeRoy Clark, W. A. Connor and Wallace S. Clark, a committee of the Rubber Covered Wire Manufacturers' Association. While the specifications submitted are not exactly those drawn up as representing the joint consensus of opinion of the Manufacturers' Committee and the Association's Committee, the committee of the Association presents them for discussion and recommends their adoption for use on signal circuits carrying current at pressure of 600 volts or less.

The committee suggests that it be permitted to continue its work and make later report on the matter of underground, submarine and aerial cables.

Specifications for Rubber Insulated Signal Wire—600 Volts or Less.

1. Conductors.—Conductors must be of soft-drawn, annealed copper wire having a conductivity of not less than 98 per cent. of that of pure copper. Each wire forming a conductor must be continuous without splice throughout its length, must be uniform in cross section, free from flaws, scales and other imperfections and provided with a heavy uniform coating of tin.

2. Rubber Insulation.—The vulcanized rubber compound shall contain not less than 30 per cent. nor more than 33 per cent. by weight of fine dry Para rubber which has not previously been used in rubber compound. The gum itself shall not contain more than 3½ per cent. of resinous extract. The remaining 70 per cent. of the compound shall consist of mineral matter only. The insulation must be tough, elastic, adhering strongly to the wire, must be homogeneous in character and placed concentrically about the conductor.

3. Taping and Braiding.—(a) The rubber insulation must be protected with a layer of cotton tape thoroughly filled with a rubber insulating compound, lapped one-half its width and so worked on as to insure a smooth surface.

(b) The outer braid must consist of one layer of closely woven cotton braiding $^{1}/_{32}$ in. thick, saturated with a black, insulating, weatherproof compound which shall be neither injuriously affected by nor have injurious effect upon the braid at a temperature of 200 deg. Fahrenheit.

4. Tests.—The manufacturer must provide at his factory all apparatus and other facilities needed for making the required physical and electrical tests and must provide the buyer's representative with all facilities for assuring himself that the 30 per cent. of rubber as above specified is actually put into the compound. The inspector shall not be privileged to ascertain what mineral ingredients are used in making up the remaining 70 per cent. of the compound. The manufacturer shall give free access to the place of manufacture and opportunity to test at all necessary times. Tests will also be made upon the finished product after delivery, and the wire will be rejected if it fails to meet the requirements of the specifications. The manufacturer must pay freight charges for return of all wire that may be rejected by the railroad company.

5. Physical Test of Copper Conductors.—Each solid conductor must stand an elongation of 25 per cent. of its length in 10 in. before breaking. In torsion it must stand before breaking 30 twists in 6 in. It must be capable of being wrapped six times about its diameter and unwound without showing signs of breakage after this process has been gone through twice. The tension and torsion tests will be made on separate pieces of wire.

6. Conductivity Test of Copper.—The conductivity of the copper shall be determined by measuring the resistance of a length of the wire and comparing with Matthiessen's standard of copper resistance.

7. Tests of Tinning.—Samples of the wire shall be thoroughly cleaned with alcohol and immersed in hydrochloric acid of specific gravity 1.088 for one minute. They shall then be rinsed in clear water and immersed in a sodium sulphide solution of specific gravity 1.142 for 32 seconds and again washed. This operation must be gone through with four times before the wire becomes clearly blackened.

8. Tests of Braiding.—Six-inch sample of wire with carefully paraffined ends shall be submerged in fresh water of a temperature of 70 deg. Fahrenheit for a period of 24 hours. The difference in weight of the sample before and after submersion must not be more than 10 per cent. of the weight of the sample before submersion less the weight of the copper and vulcanized rubber.

9. Physical Tests of Rubber Insulation.—A sample of the vulcanized rubber insulation not less than 4 in. in length shall have marks placed upon it 2 in. apart. The sample shall be stretched until the marks are 6 in. apart and then at once released. One minute after such release the marks shall not be over 2⅜ in. apart. The sample shall then be stretched until the marks are 9 in. apart before breaking and must have a tensile strength of not less than 800 lbs. per square inch.

10. Chemical Tests of Rubber Insulation.—The vulcanized rubber compound shall contain not more than 6 per cent. by weight of acetone extract and not more than 0.7 per cent. of free sulphur.

11. Electrical Tests of Rubber Insulation.—The circular mills cross-section, the thickness of the rubber insulation (measured at the thinnest point), the minimum insulation resistance in megohms per mile and the dielectric strength for the various sizes of wire shall conform to the following table:

Size B. & S. gage.	Area in circular mills.	Thickness of insulation.	Insulation resistance, megohms per mile.	Test voltage alternating current.
0	105,592	⅛-in. wall	1,200	10,000
1	83,694	⅛-in. "	1,300	10,000
2	66,373	⅛-in. "	1,400	12,000
4	41,742	$^{3}/_{32}$-in. "	1,300	9,000
6	26,250	$^{3}/_{32}$-in. "	1,500	9,000
8	16,509	$^{3}/_{32}$-in. "	1,700	9,000
9	13,090	$^{5}/_{64}$-in. "	1,700	7,000
10	10,380	$^{5}/_{64}$-in. "	1,800	7,000
12	6,530	$^{5}/_{64}$-in. "	2,000	7,000
14	4,107	$^{5}/_{64}$-in. "	2,100	7,000
16	2,583	$^{1}/_{16}$-in. "	1,900	4,000
18	1,624	$^{1}/_{16}$-in. "	2,000	4,000

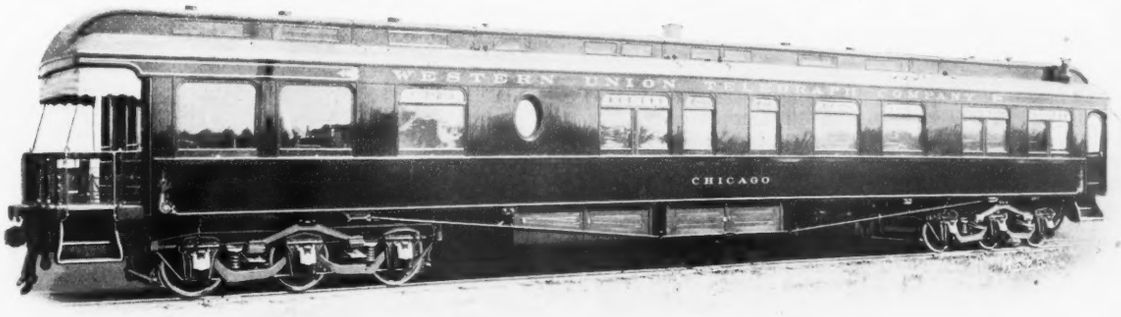
The test for insulation resistance must be made upon all wire after at least 48 hours submersion in water and while still immersed results being corrected to a water temperature of 60 deg. Fahrenheit. Tests must be made before the application of tape, braid or other covering with a well insulated battery and galvanometer, with not less than 150 volts and readings must be taken after one minute's electrification. The test voltage must be applied to the completed length of wire before the insulation test for a period of five minutes, using alternating current from a generator and transformer of ample capacity.

Labor Agitation in England.

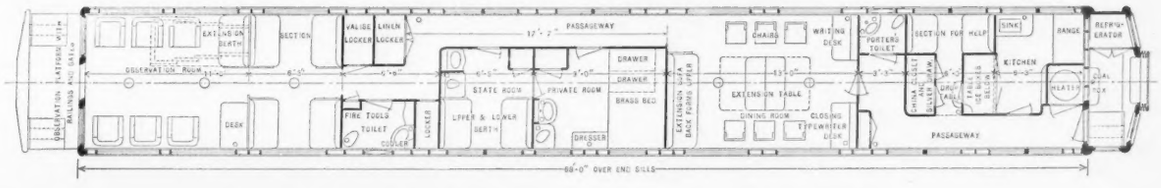
By way of engineering the "national conference" which is proposed by the Amalgamated Society of Railway Servants of England for this November to formulate a programme for improvement of hours and wages of all grades of railroad servants, preparatory meetings are being arranged at various railroad centers and resolutions are being passed for such things as a universal eight-hour day, a minimum wage of 12 cents an hour and a guaranteed week's work for everyone. But the managers of this agitation seem to have an uneasy feeling that they are unlikely to get anything like what they want unless they can enlist public sympathy on their side, and so harrowing details are published about engine drivers being forced to work for 15 or 16 hours a day and goods guards being kept on duty for over 20 hours. The union leaders will have, however, to persuade the public that the railroads habitually and systematically impose excessive working hours on their servants, and to do this a few isolated instances are by no means sufficient.

Private Car "Chicago" of the Western Union Telegraph Company.

A private car for the use of Mr. Thomas P. Cook, General Superintendent of the Western Union Telegraph Company, has recently been turned out by the Hicks Locomotive & Car Works, Chicago. Utility was a primary object determining the interior arrangement and finish, and Mr. Cook's own ideas were embodied in various features. The car is 68 ft. over end sills, 9 ft. 8 in. over side sills and 13 ft. 11 in. high (New England height) over all. Its exterior appearance is shown by one of the engravings.



Private Car "Chicago" Built by the Hicks Locomotive and Car Works.



Floor Plan of Private Car "Chicago," Western Union Telegraph Co.

Interior of Dining Room.

Being a business car, the interior finish and decoration is plain, though attractive. It is in quarter-sawed oak, golden finish, the style being flat with a single inlay. The design is intended to furnish the minimum of dust-catching surface consistent with attractive appearance. The ceiling is semi-empire deck in a light olive color with gold leaf decorations. The seats in the observation and staterooms are upholstered in olive frieze plush; the sections adjoining the observation room are similarly upholstered. Leather is used in the dining room. The seat in the observation room is an extension berth, and the sofa berth in the dining room is arranged for the back to form an upper berth, making sleeping accommodations for ten people in addition to the help. The stateroom has full-section upper and lower berths, white metal washstand and hopper. The private room adjoining has brass bed, dresser, white metal washstand and hopper. The stateroom and private room both have large lockers, and the brass bed has two large drawers underneath opening into the private room and intended for clothing. There is also space under the brass bed for one or two steamer trunks. One aim in designing the car was to provide as much closet and wardrobe space as possible for the convenience of the occupants.

There are three desks in the car. The one in the observation room is a small flat-top desk with two drawers underneath and occupies a space against the section on one side. In the dining room there is a folding typewriter desk at one side of the passageway door and a small drop-lid desk with pigeon holes and drawers on the other side. Above both are bookcases extending to the crown molding. The car has large china and linen lockers and a small but fully equipped and conveniently arranged kitchen with ice boxes and all conveniences. The refrigerator on the forward platform extending to the hood has capacity for 200 lbs. of ice. The ice boxes under the car have capacity for 1,000 lbs. and other boxes for provisions are ample for an extended stop at any point. Water capacity and gas storage are also large, providing ample hot and cold water and Pintsch gas for lighting during any delay to the car on account of special work on the line.

The unusual form of the windows in the observation room will be noted. There are no upper sash or gothics, making the entire window opening available for light and observation, enabling the occupants of the room to see easily the tops of telegraph poles along the line.

Testing Coal.*

BY A. BEMENT.

It is the principal object of this paper to emphasize the necessity for improving the practice governing specifications and inspection, and also to suggest certain lines along which the research work should proceed, and it is fuel coal from the Eastern interior coal basin that is more particularly considered.

The improvements and corrections which concern terms of specifications, and the inspection service, require that determinations of the following be abandoned:

Moisture,
Volatile matter.
Fixed carbon.
Sulphur,
Evaporative power of the coal.

Every essential requirement of the purchaser may be fulfilled by confining specifications and tests to the three following charac-

*A paper presented before the Western Society of Engineers, Oct. 3.

teristics; in fact, these three features alone will insure greater protection to the purchaser than obtainable under present general practice:

Per cent. of ash in the dry coal.
Size of the coal.
Heating power of the pure coal.

The latter, according to prevailing practice, would preferably, of course, be expressed in British thermal units.

The reasons for the above recommendations are given under the following captions:

MOISTURE.

Moisture is a great and uncertain variable. It not only differs in various coal seams as the coal lies in the ground, but is affected in fuel as received in shipment, by conditions of weather, temperature and time the coal may be in transit. It is approximately correct, however, to say that each coal seam has a characteristic moisture content of its own, which is uniform over at least very considerable areas, but the after influence above mentioned changes it, so that there is no assurance of what it may be except under specially defined conditions.

Therefore, the producer or coal dealer can exercise no control over moisture, and as the prime object of fuel inspection service is to insure that the customer is served to the best ability of the dealer, specifications and tests of moisture in coal delivered can offer no protection to the purchaser. As before mentioned moisture varies in different coal seams; for this reason it might appear that its determination would indicate the seam from which the coal came. This is not true, however, for reasons above mentioned. If tests are expected to identify the seam which produced the coal other means must necessarily be employed.

However, in coal inspection service, moisture has been found to be very high in cases where delivery is by wagon, which, owing to lack of sufficient explanation of phenomena at the time, may have led to the opinion that the dealer wetted the coal for the purpose of increasing its weight at the time of loading. If this is the practice, it necessarily complicates the problem, but the writer has had cause to visit every coal yard in Chicago, and never observed any wetting of coal or any appliances for such purpose. It would be a difficult and expensive matter to wet fuel as loaded, and require water pipes located along team tracks, which in some cases extend for several hundred feet, and with the finer sizes of coal it would necessitate a man stationed at each wagon to supply water as fast as the coal was loaded, otherwise it would be impossible to add any great amount, because simply flooding the top of a wagon load of screenings, for example, would only insure the upper surface being wetted as the water would not penetrate the mass. A further study of this matter has made it appear to the author that this high moisture in wagon delivered coal, is due to the practice of wetting coal while it is being unloaded, very often done for the purpose of allaying dust, and to the water which is commonly added in the fire room for various reasons, both prior to the time of sampling.

This matter of moisture also complicates the problem as far as the inspection service is concerned, because it is impracticable for the inspecting company to have its sampler present when a wagon load of coal arrives, as it would entail an expense which the service could not bear. Also, sampling attempted at the time of unloading could not be properly performed, as the sampler would be unable to gather from a wagon at the sidewalk and prepare a sample as it should be done. Thus it appears, that the determination of moisture, even in wagon delivered coal, serves no useful purpose. With fuel received in cars, there could, of course, be no opportunity for adding water.

VOLATILE MATTER.

No fuel coal of this locality is purchased for the purpose of making gas or for use in by-product recovery plants, therefore tests for this constituent are unnecessary, unless there be a great difference in the coal. "Volatile matter" is not very well understood. The best conclusion is that coal is a complicated hydrocarbon which breaks down in distillation into various fractions, depending upon temperature and duration of heating period, and that the difference in coal of this basin is not greater than that due to the varying effect produced by the volatilization test itself; or, in other words, the variation may be caused by the test rather than by the composition of the coal. Thus the volatile matter test is not sufficiently accurate to be of service in this case. It is, of course, true, that it would distinguish between bituminous, semi-bituminous and anthracite coal, but one may do this merely by inspection without any test whatever.

All coal of this basin is high in "volatile matter"; all will make smoke if burned in sufficiently bad furnaces, and all will make smokeless combustion and good efficiency in good furnaces.

FIXED CARBON.

In coal analysis the disposition is to follow precedent. Coal mining became an important industry in the East long before it did in this locality. Much coal in the Appalachian basin is suited to the manufacture of a high grade of coke, and the amount of residue, or, in other words, the coke obtained under the conditions of the process, is a matter of first importance. This has had the effect of emphasizing the importance of "fixed carbon," so that it has been looked upon in many quarters as of more moment than any other characteristic of coal, and these ideas, extending to our locality, have to a considerable extent influenced opinion regarding fuel. The same remarks regarding the uncertainty of the determination of volatile matter apply to that of fixed carbon, because the test for the former is the one giving data for the latter. If coke was made from coal of this locality, it would be possible under certain conditions, to make a useful application of the test for fixed carbon; inasmuch, however, as it is not the case, this constituent is only a troublesome and misleading feature of analysis.

SULPHUR.

Sulphur has been in a measure treated in the past the same as fixed carbon. In metallurgical work it is of extreme importance, and in this connection has received more attention than with fuel coal. This has given a prominence to the sulphur determination which it would not otherwise possess, and upon the assumption that sulphur is in the form of pyrites or very largely so, the conclusion has been accepted that the amount of sulphur is an indication of the tendency of the ash in the coal to clinker. This is true, however, to only a slight extent; in fact, may not even be considered as a working hypothesis in this coal basin, because some of the seams which are the highest in sulphur produce the least clinkering, therefore conclusions regarding the behavior of the ash in this respect, are not justified by the amount of sulphur in the coal.

EVAPORATIVE POWER.

This is something which should never, under any circumstances, become a feature of specifications or guarantees, for several very important reasons. In general, too many variable factors enter into the problem. For example, boilers differ, some being more efficient than others, absorbing greater or less amounts of heat from the coal for reasons due to their individual superiority or inferiority. Then furnaces differ greatly; in some cases all of the volatile matter may be burned; in others, a large portion be wasted. Again, fire grates differ in like measure, causing varying losses of fuel which falls into the ash pits, and the combination of grate and furnace has an important influence on the excess of air which necessarily enters, and for this latter reason, also, the useful result obtained from the coal is affected to a marked extent. The above refers to the characteristics of the apparatus itself, but at this point another and most serious variable must be considered, that of the personal equation of the fireman or furnace operator; therefore it is apparent that in such a test, one may be unable to discover whether the result is due to the fuel, the peculiarities of the apparatus or its manipulation. In the case of a coal purchaser who does not realize these facts, the result is always attributed to the object in view, which is, in such instance, to determine the value of the coal. If he had wished to discover whether he employed a good fireman or not, the experiment would have been precisely the same, and he would have then considered the result due to manipulation. It is not only the above features which have an important influence, but the character of the load on the plant is a matter of great moment. In a works where boilers run steadily for 24 hours, the result secured, everything being equal, will be much better than in one where the work is necesarily interrupted by stoppages at noontime, shutting down at night, or with peaks of load as in electric railway service. Any one of the foregoing causes may exercise a greater influence on the evaporative result secured than that due to variation in fuel.

It is not intended in the above to imply that coal burning experiments are not useful, because there are some things which may be settled as affecting certain plants; for example, fuel high in ash generally costs less per ton than that containing less ash, and it might be a question which would be the most economical to use; or, the matter of the most desirable size of fuel may be in question. These two are the only features which can be settled by burning coal under a boiler, and they should not be made part of a specification or guarantee, but used entirely for the guidance of the fuel user in selecting the best grade.

The behavior of coal under boilers is a problem very little understood, because it is the result of many variable influences, and for this reason it is often felt that the calorimetric test is unreliable, which, however, is not true, because the calorimeter does its work very accurately as far as the coal itself is concerned, and its efficient utilization in service is influenced only by the amount and fusibility of the ash associated with it and the size of the pieces of the fuel. This matter has been extensively treated elsewhere.

It is well in this connection to direct attention to the fact that there is a feeling more or less prevalent, that coal from different localities or seams, may possess some undefinable peculiarity in its chemical combination, which causes it to behave differently under a boiler than it would be in a calorimeter. Such conclusion is untenable, because the process is identical in each case, that of combination of oxygen with the carbon, hydrogen and sulphur of the

coal, and this combination cannot be any different under the boiler than in the calorimeter, unless certain influences due to the peculiarity of the boiler apparatus and its manipulation assert themselves, and it is the disposition as far as the coal is concerned, to blame it for effects which are due to causes other than its chemical composition. It is well in this connection, to call attention to the fact that the heating power of the coal proper, or, in other words, the pure coal in Illinois, only ranges from 14,000 as a minimum, to 14,750 British thermal units as a maximum, and that about 80 per cent. of the fuel produced ranges between 14,000 and 14,500 British thermal units per pound. Thus the enormous variation found in service under boilers as far as the amount of water evaporated per pound of coal is concerned, is mostly due to the characteristics of the apparatus, its manipulation, and to the size of the coal and the amount of ash associated with it.

Thus it is very clear that specifications or guarantees covering amount of evaporation per pound of fuel or per cent. efficiency, are not only useless but troublesome to the purchaser and dealer.

The three approved tests may now be considered, and while in the above classification they are presented in the order of greatest importance, it will be convenient to change their arrangement.

PURE COAL.

For better understanding, it is desirable to consider coal as the chemical combination of certain elements which are principally heat producing. The association of ash and moisture with these, results in an aggregation which may be designated as fuel, although generally called coal, which, from this standpoint, however, is not correct, because neither ash nor moisture produce heat.* The expression, pure coal, is the equivalent of what has erroneously been called combustible, the pure coal containing all of the combustible matter, and some water of composition and nitrogen which are not combustible, but as these two ingredients are associated chemically with the combustible, the ultimate conception of coal is covered by this term, pure coal. Thus in the heating power determination, it is more to the point to base results on the pure coal than on any of the fuel mixtures, illustrated as follows: Let it be assumed that in one case the B. t. u. per pound of dry coal is 13,250, and in another 12,450, from which it would appear that the two lots of fuel were different, but if the percentage of ash content in each is known, and the first sample contained 7 per cent. and the latter 12 per cent., it appears that each sample has a pure B. t. u. of 14,250, or, in other words, that the coal is the same in each, there simply being more ash associated with it in one case than the other. Basing the heating power determination on pure coal has another very important advantage, as it enables one to judge of the accuracy of analysis, because when the heating power and the source from which the coal comes is known, there is evidence indicating whether or not the analysis has been correctly performed, because, if it has not been, it will be shown by the B. t. u.

ASH.

An important reason why ash should always be considered as a percentage of the dry coal instead of the moist fuel, is, that like the B. t. u. determination, unless it is placed on some common basis, proper comparison cannot be made on different lots of fuel; for example, in two samples, the moisture may be 8 and 13 per cent. and ash in the dry coal 10 per cent. in each, but expressed on the moist coal basis, it appears that one has 8.7 and the other 9.2 per cent. of ash, and it would seem that one of the fuels contained more than the other. In this connection the fact should be borne in mind, that no one burns moist coal; the moisture is evaporated and passes away; in fact, dry coal is not burned, the ash remaining; it being the pure coal which enters into the process of making fire.

SIZE OF COAL.

As a general proposition, the value of fuel increases with the size of the pieces, so that a very fine "duff" is of little use, but as the pieces become larger, the actual value increases in a greater ratio than does the heating power, and this continues to egg size and lump. Thus smaller pieces containing the same amount of heat per pound as larger ones, are of less value than the larger coal.

The size of the pieces of coal exercises an important influence, not only on the capacity which may be produced by a boiler, but on the resulting efficiency, and the best size to be used in a given case is dependent upon many conditions, such as the strength of draft, kind of stoker or grates, method of firing, etc., and the selection of the proper size of fuel or the method of utilizing the available size, often affords an opportunity to effect important economies.

SAMPLING.

One feature of the matter, referring especially to coal inspection service, is proper and reliable sampling. In very many cases the coal inspection service is rendered by a company, which, while acting as the purchaser's representative, is depended upon to furnish the seller with reliable reports concerning the composition of coal supplied. Under such conditions, it is absolutely necessary that not only shall the inspecting chemist be both competent and reliable, but that he shall be as fully responsible for the collection of the sampes as he is for the analytical report, and it is also absolutely essential that the purchaser or his employees shall not be allowed to sample any coal or assist in the sampling, because under such conditions, the chemist may not know whether the report which he makes is correct or not, and it is well to emphasize the fact that the sampling is of as great importance as the analysis itself.

Referring to the branch of the subject before mentioned as that of research, there has been in operation for some years at St. Louis, what has been designated as a fuel-testing plant, under the direction of the United States Geological Survey. Its principal published work so far, however, has been largely confined to "tests" under boilers, which have been thought to show the "real steaming value" of the fuel. The author's remarks above regarding testing coal under boilers will refer to this branch of the work.

Probably the reference to coal in the plural has done much to cause confusion, because it has led people to believe that there are very many "kinds" of coal. For example, fuel from Herrin and Carterville in this state would, according to this, be considered as different "coal," when, as a matter of fact, they are from the same seam, and the most exact analytical tests so far made, do not indicate a difference. The amount of ash associated with the coal may or may not vary, but the coal is the same, and it is coal and not coals, otherwise, every mine would produce a different kind of coal, notwithstanding the fact that seams in Illinois sometimes run through an entire county without it being possible to detect any variation in the quality; therefore, the expression, kinds of coal, which has been used frequently in connection with coal-testing work, should not only be better defined, but limited in its application to those cases where there is a real difference, which, as is well known, does exist; for example, it must be conceded that anthracite and bituminous are different kinds of coal, but the most liberal application to this coal basin would allow only two kinds, which are the block coal of Indiana, all the remainder being bituminous, the latter also including what is known as semi-block of Indiana.

The state of Illinois has made an appropriation covering cost of investigations to be conducted by the Engineering Experiment Station of the University of Illinois, and there is certain important work which it is hoped will be undertaken, having a bearing on the values of fuel, studies tending to define the laws controlling the influence due to the size when burned with some different kinds of stokers or grates, and similar studies to ascertain corresponding effect due to varying amounts of ash in coal, also degree of fusibility of such ash.

The recently established State Geological Survey will present by all means a very much better coal report than has so far been published by any state, and it will be a great help to the purchasers and producers of coal, if certain values as affecting heating power, ash and moisture are authoritatively presented. As before mentioned, the three essential items are heating power of the pure coal, percentage of ash in the dry coal, and moisture. The B. t. u. values would be the simplest of the three, as these results would apply to pure coal, and are, no doubt, practically constant for a particular locality of a seam; therefore, once determined, it will not be necessary to repeat tests. Establishing ash values would be a more difficult matter, because it would not only involve ash in seams as the coal lies in the ground, but the various grades of fuel shipped from those seams. Ash, however, at the mine would be the same in quantity as when received by the consumer. Securing moisture values would be a far more complicated problem, because of greater variation due to temperature, weather conditions and time in transit. For these reasons, it is difficult to arrive at any conclusion regarding the amount of work which may be justified in the establishment of such values. Some idea of the complication may be illustrated; for example, the washed and sized coal shipped so extensively from Williamson County has a characteristic moisture content due to the difference in the size of the pieces, the larger ones being drier, and these moisture contents vary over wide ranges between summer and winter, and also according to the length of haul; thus at least average moisture values would be needed for each size, at the city where the coal was received.

A recent expression which has come into use, is that of "air-dried coal," which is based upon allowing the sample to become dried in the open air of the laboratory, the idea being that this shows the fuel as it would reach the customer. No standard conditions, however, appear to be employed in this air-drying, and if there were, the values obtained thereby do not indicate the amount of moisture in coal when it reaches the consumer. Some samples of air drying on Illinois coal have shown the moisture as being between 5 and 6 per cent., when as a matter of fact the same coal

*Journal American Chemical Society, Vol. XXVIII, page 632.

is never received with less than 7 per cent. and in the winter time it is very much more. This moisture value should be abandoned, as it serves no useful purpose, tending only to increase existing confusion and misunderstanding.

Cross-Ties Purchased by the Steam Railroads of the United States in 1905.*

The following report upon the cross-ties purchased by the railroads in 1905 is based upon statements from 770 steam railroad companies. Of those which failed to report, only one operates more than 1,000 miles of track, and that one less than 1,300. The average mileage of the remainder is approximately 45. The total mileage unreported is 8,671. Since the total trackage in the United States on Jan. 1, 1905, was, according to Poor's Manual, 293,937 miles, the unreported trackage amounts to but 2.9 per cent. of the total.

These statistics do not necessarily represent the number of cross-ties used in 1905, since they are compiled from the statements of ties purchased. However, the total represents, with a very fair degree of accuracy, the actual number of ties laid.

The total number of ties reported is 77,981,227, switch ties being reduced to an equivalent number of cross-ties. Of the total number of ties purchased, 14,459,521, or approximately 18.5 per cent., were for use in the construction of new track, leaving 63,521,706 for renewals. Assuming that the unreported 2.9 per cent. of track required ties in the same proportion as the reported trackage, the total number of ties purchased by the steam railroads of the United States in 1905 was 81,562,150. Estimating 10,000,000 additional ties for the electric lines, the total number of ties purchased last year in the United States was, in round numbers, 91,500,000.

Oak, the greater part of which is doubtless some variety of white oak, furnishes 44.5 per cent., or almost one-half, of the total number of ties. Assuming that the average tie contains 30 ft., board measure, the amount of timber represented by the white-oak ties is over one billion board feet, or approximately one-fourth of the total amount of oak lumber produced in one year. Nearly all of the oak is converted into hewed ties, only 12.6 per cent. being sawed.

Pine ranks next in importance, with 23.5 per cent., and while it cannot be definitely stated just what proportion should be assigned to the various species, it is certain that more than three-fourths of the pine ties are southern yellow pine. The white and Norway pines should be credited with from 3 to 4 per cent. and the western yellow pine of the Rocky Mountain and Pacific Coast regions with from 17 to 18 per cent. Cedar ranks third with 8.9 per cent., followed closely by chestnut with 6.1 per cent. Both of these species are excellent tie woods and would figure more largely in the total production were it not for the limited distribution and supply of each. The percentage of the total number of hewed and sawed ties is, hewed, 77.4; sawed, 22.6.

Statistics are lacking for a comparison of the present output of ties with the number from each kind of timber in other years, but it is probable that were they available it would be shown that the number and proportion of the pine ties have increased materially within the last decade. Correspondingly, the proportion of oak ties would doubtless show a decrease for the same period.

The four leading kinds of timber for ties are oak, pine, cedar and chestnut, which combined furnish 83 per cent. of the total number, oak and pine alone furnishing 68 per cent. Next in rank is the red fir of the Pacific Coast and Rocky Mountain region with 4.6 per cent., followed by the cypress of the South with 4.5 per cent. The tamarack, or eastern larch of the New England and Lake states, and the eastern hemlock are the only other species credited with more than 1 per cent. of the total number. Beech, birch and maple were reported in amounts of less than one-tenth of 1 per cent. each. The miscellaneous classification includes a number of woods, among which the most important are red gum, black locust, elm, hickory and red cedar. Thus some 20 kinds of timber enter into the production of railroad ties, but of these only seven, at most, are important.

Until a comparatively short time ago the railroads were usually able to secure an ample supply of ties from lands adjacent to their rights of way. This has been especially true of the vast network of lines which traverse the territory east of the Mississippi river. While this source is by no means exhausted, it has become seriously depleted, and where in former years the purchasing agent could contract for an almost unlimited number of white-oak ties with the assurance that they would be promptly furnished, at the present time it is necessary to contract for small quantities and to anticipate the demand far in advance.

Wherever the whole tree is worked up into ties, sawing permits of by far the closer utilization of material. From this it might be inferred that the present practice of hewing the majority of the ties is poor policy, judged from the standpoint of economy. As a matter of fact, however, little of the material which is converted into hewed ties is saw timber, consisting, as it does, of tops left from lumbering both conifers and hardwoods, or small trees from which, even though sawed, little, if any, additional tie stock could be secured, and heart timber full of knots, shake and similar defects.

Where the tie was once the major product, it is now generally a minor product. The Pacific Coast is practically the only region in the United States where ties are produced as a major product of the forest. One of the most important sources of the ties in the east is the farmer's woodlot. During the winter in this region large numbers of ties are hewed and hauled to the railroads.

In determining the geographical distribution of the regions of supply, it was found impractical to attempt a classification by states on account of the manner in which the railroad companies furnished the information on this item. It was found possible, however, to determine the source, with a degree of certainty, by grouping the states as follows:

Region.	States included.
Southern	Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Texas, Indian Territory.
Central	Ohio, West Virginia, Kentucky, Tennessee, Indiana, Illinois, Missouri.
Lake	Michigan, Wisconsin, Minnesota.
North Atlantic	New England States, New York, Pennsylvania, New Jersey, Delaware, Maryland.
Pacific Coast	Washington, Oregon, California.
Rocky Mountain	Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico.

The Southern States rank first, furnishing over 38 per cent., while the Central States rank next with nearly 23 per cent. of the total number of ties. These groups of states, which comprise practically all of the great hardwood forests of the country and all of the cypress and southern pine forests, furnish nearly two-thirds of the number of ties. The Lake States rank next with 15 per cent., followed closely by the North Atlantic with about 13 per cent. Thus it will be seen that practically 90 per cent. of the ties are now obtained east of the Rocky Mountains. The Pacific Coast and Rocky Mountain regions, as yet, are not very important factors in the production of ties. This is explained by the fact that these regions at the present time probably do not supply tie material for much trackage beyond their limits, since the long haul to the eastern market makes it impossible for their ties to compete successfully with ties produced in the east.

The method of production in the Pacific Coast region, as compared with other regions, is striking. The Pacific Coast is the only region in which more sawed than hewed ties are produced, 82.3 per cent. being sawed. Practically the opposite condition is found in the Southern, Lake and Central regions. The Rocky Mountain region follows next in proportion of sawed to hewed ties. Here, however, but 35 per cent. are sawed. This condition is explained in part by the fact that timber is more plentiful and the stumpage value lower in the west than elsewhere; consequently the market for the lower grades of lumber is poor, and as there is always a ready market for ties, much of the lower grades is sawed into ties. Other factors also have an influence, the most important of which is the sparse population, which deprives the region of the supply obtained from farmers' woodlots, an important feature in the eastern tie market. While it is not to be expected, as with the production of lumber, that the Pacific Coast will ever become the chief source of supply for railroad ties, nevertheless the proportion will doubtless steadily increase.

The statistics for 1905 show that 7,510,000 ties, or nearly 10 per cent. of the total number purchased, were given a preservative treatment of some character. During 1905 at least ten railroad companies were operating their own plants for the preservation of their construction material, and several others are contemplating the installation of such plants. In addition to the roads which treat their own timber, many others have their timber treated at commercial treating plants.

*Extracts fram Circular 43, of the U. S. Department of Agriculture, Forest Service.

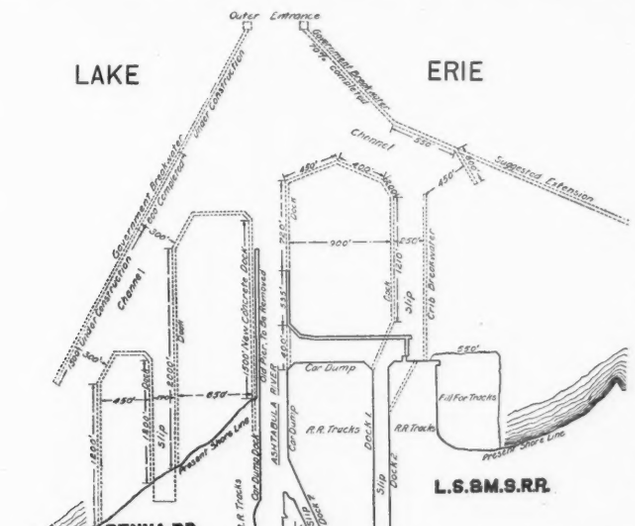
Chinese Railroads.

The Chinese Government has failed to fulfil its promise to provide funds for the completion of the Shanghai-Nanking Railroad. Tang Shao-yi has since informed the British Legation that an edict in reply to his memorial for the provision of funds will probably be issued shortly. This policy of constant disregard of promises is difficult to understand. It was also difficult to understand why China should authorize the construction under an imperial guarantee of railroads joining the three great centers of population—Shanghai, Su-chau and Nanking—and then permit officials like the corrupt Sheng or the conservative Viceroy Chau-fu to prevent the railroad from coming nearer than five miles to Nanking city wall or nearer than four miles to the business quarter of Su-chau. The negotiations for the Kau-lung-Canton Railroad were opened recently. The 90-mile railroad from the mines to the waterway is not earning running expenses, and the guarantors, the Pekin Syndicate, are compelled to pay 1,500 taels (about $1,100) a month

for losses in working, in addition to the $175,000 per annum guarantee. The Pekin Syndicate, however, hopes that if the water difficulties can be overcome prospects will improve. Meanwhile the syndicate has arranged to purchase 15,000 tons of coal from the native coal mines in the vicinity of the syndicate's mines and to transport the coal by junk to Tientsin for sale during the coming winter.

Harbor Improvements at Ashtabula.

Ashtabula, Ohio, is the greatest iron ore receiving port on the Great Lakes. The receipts during last July were 1,077,526 tons; the next largest receipts being at Cleveland, 1,003,650 tons. The Lake Shore and the Pennsylvania are now jointly making extensive improvements at this harbor. On the accompanying plan, the heavier lines show the present shore line and piers, and the dotted lines indicate the new shore line and breakwaters. The railroad companies are to build the government breakwaters, the Lake Shore doing the work on the eastern ones and the Pennsylvania finishing the others. As the plan shows, the present slip is entered by a channel from the mouth of the Ashtabula river. Cribbing will be built across both ends of this channel, and out into the lake for 1,655 ft., enclosing a space 900 feet wide, which will be filled in. This will need 1,500,000 cu. ft. of earth for the fill and 100,000 tons of stone for the crib work. The new entrance, 250 ft. wide, to the slip will be to the east of this fill and will be protected by a crib breakwater. All of the new channels and slips on both sides of the river will be dredged to a depth of 21 ft.; this will mean, in places, a 10 ft. cut in solid rock. West of the river the Pennsylvania is reclaiming two sections of ground, leaving between them a new slip 170 ft.



Ashtabula Harbor Improvements.

wide. The fill nearer the river is 1,500 ft. long on the east side and 2,000 ft. on the west side, and will be 650 ft. wide. The present pier extending out from the mouth of the river is to be removed when the new concrete dock, extending the entire length of the new fill, is completed, thus making the extended river channel 60 ft. wider. The extreme western fill will be 1,200 ft. long and 450 ft. wide. There are at present 1,000 men at work and it is expected that the improvements will be completed in three years. The total cost is estimated at $7,000,000.

Foreign Railroad Notes.

Among the first results of the new railroad from Orenburg to Tashkend is the supplying of European Russia with fruit, Turkestan (where there is any water) being a sort of Asiatic California. Last July it was reported that one car daily loaded with apples and pears and another loaded with peaches and grapes were despatched from Samarcand to Moscow daily. The time on the road was six to eight days.

The Austrian State Railroads have raised the minimum pay of a permanently appointed employee from $280 to $320 a year, and dated back the time for receiving this pay to July 1 last. It has also promoted a large number of old and approved employees from the class which receives $560 to $640 a year to the next highest class, which for most of them will be their final promotion, in which the pay is $720 to $880. This also dates from July 1. The railroad men had been complaining for years that their pay and promotions had not kept pace with conditions in other employments.

Exhibits at Street Railway Convention.

The following is a list of the makers of steam railroad specialties exhibiting at the American Street and Interurban Railway Convention, Columbus, Ohio, Oct. 15 to 19:

Adams & Westlake Co., Chicago.—Signal lamps, headlights, car-trimmings, brake-handles, switch-lamps, electroliers.

Allis-Chalmers Co., Milwaukee, Wis.—Machinery and large framed photographs illustrative of complete electric railway equipments—for power houses, sub-stations, cars and lines, including Christensen air-brake apparatus; supplemented by bulletins; also model showing the stationary and movable blading of an Allis-Chalmers steam turbine.

American Brake Co., St. Louis.—Exhibit with Westinghouse.

American Brake Shoe & Foundry Co., Mahwah, N. J.—Brake-shoes and brake-heads.

American Car Co., St. Louis.—Exhibit with J. G. Brill Co.

American Locomotive Co., New York.—Motor trucks built for the New York Central & Hudson River Railroad to be equipped with two motors of 200 h.p. each, to be supplied by the General Electric Co.; load on center plate, 40,000 lbs.; weight of motors, 15,300 lbs.; weight of truck and motors, 27,700 lbs.; one trailer truck for the same company, load on center plate, 38,000 lbs.; weight complete, 11,000 lbs.

American Mason Safety Tread Co., Empire Safety Tread Co., Boston.—Mason safety tread for car steps, Empire carborundum safety tread.

American Railway Supply Co., New York.—Badges for conductors and motormen.

American Sewer Pipe Co., Pittsburg.—Sewer pipe.

American Steel & Wire Co., Chicago, Ill.—Rail bonds, wire, trolley wire, wire fence and a complete line of rail-bonding tools.

American Water Softener Co., Philadelphia, Pa.—Working model of water-softening plant and photographs of plants that have been installed.

Atha Steel Casting Co., Newark, N. J.—Titian gear wheels.

Atlas Railway Supply Co., Chicago, Ill.—Atlas supported and suspended rail joints for tee and girder rails, Atlas compromise or step points, special rail joints, plain braces and tie-plate braces, tie-plates, switch-stands and primer and surfacer for passenger cars.

Baldwin Locomotive Works (Burnham, Williams & Co.), Philadelphia, Pa.—One truck in this space, four trucks under cars in Niles exhibit and two trucks under cars in Jewett exhibit.

Baldwin Steel Co., New York.—Hudson high-speed steel, twist drills, gear cutters, milling cutters, taps, reamers, end mills, metal-slitting saws.

Baldwin & Rowland Switch & Signal Co., New Haven, Conn.—A recording signal operated automatically.

Berry Bros., Detroit, Mich.—Panels finished with inside and outside coach varnishes.

Bird & Son, F. W., East Walpole, Mass.—Paroid roofing, Neponset waterproof papers for sheathing purposes, special papers.

Blake Signal & Manufacturing Co., Boston, Mass.—Blake signal.

Bowser & Co., S. F., Ft. Wayne, Ind.—Oil storage systems, oil tanks and pumps, self-measuring oil tanks.

Brady Brass Co., Jersey City, N. J.—Motor bearings for electric railways.

Brill Co., J. G., Philadelphia.—G. C. Kuhlman Car Co., Cleveland, American Car Co., St. Louis, and Stephenson Car Co., Elizabeth, N. J.—Various styles of cars made by these companies, among them two "Pay as you enter cars" built for the Montreal Street Railway Co.

Brown, Harold P., New York.—Plastic rail bond, plastic plug rail bond, solid copper rail bond, Brown electrical contact alloys, hand-power rail grinders, flexible shafts, high-speed electric rail drill, pneumatic rail drill, magnetic drill clamp, electrical testing bureau with 3,000 amperes capacity, insulated third rail, amalgamated switch contacts.

Buckeye Engine Co., Salem, Ohio.—Engine model.

Buhne Metal Packing Co., New York.—Fibrous Babbitt steam packing.

Burroughs Adding Machine Co., Detroit.—Adding machines.

Cambria Steel Co., Pittsburg, Pa.—100 per cent. rail joint, 100 per cent. insulated rail joint, T-rail guards for street railway use.

Capital Lock-Nut & Washer Co., Columbus.—Lock-nuts, bolts, nuts and structural rivets.

Carnegie Steel Co., Pittsburg, Pa.—Girder-rail branch-off, mounted on complete set of steel switch ties, steel cross-ties.

Cary Automatic Coupler Co., Chicago.—Cary automatic car couplers and Cary automatic train-pipe couplers.

Chase Foundry & Mfg. Co., The, Columbus, Ohio.—Express and baggage wagons, factory and railroad trucks and industrial cars.

Chicago Pneumatic Tool Co., Chicago.—Electric drills and grinders for rail-bonding wound for line voltage, and a complete line of pneumatic drills and hammers.

Cleveland Frog & Crossing Co., Cleveland.—Mate switch and frog; steam frog, rigid center; derailing switch, ground stand, double spring frog, sample rail, also mechanism operating the derailing switch.

Climax Stock Guard Co., Chicago, Ill., and Canton, Ohio.—Climax "Clay" cattle guards, farm crossing gates.

Columbia Machine Works & Malleable Iron Co., Brooklyn, N. Y.—Armature pinion puller, armature buggy, broom-filling table, snow-sweeper broom, babbitt moulds.

Consolidated Car Heating Co., New York.—Electric car heaters, portable vestibule heater, switches for electric heaters, switches for car lights, switchboards.

Cook Manufacturing Co., C. Lee, Louisville, Ky.—Cook's metallic packing for piston rods and Corliss valve stems for both saturated and superheated steam.

Cook's Railway Appliance Co., Kalamazoo, Mich.—Standard track and automatic car-lowering jacks, cattle guards, rail drills, tool grinders.

Cooper-Hewitt Electric Co.—Exhibit with Westinghouse.

Crouse-Hinds Co., Syracuse, N. Y.—Imperial arc headlights and combination, arc and incandescent headlights. Syracuse changeable incandescent headlights, Harpoon guy anchors, Norbitt porcelain specialties, conduits.

Curtain Supply Co., Chicago.—Curtains for closed cars equipped with Forsyth No. 86, Ring No. 88, eccentric, Acme cable and Climax cable fixtures; also ring fixture No. 49, adapted for semi-convertible cars, curtains for open cars equipped with Acme, Climax and Forsyth cable fixtures and ring fixture with projecting pins and metal-retaining strip.

Davis Pressed Steel Co., Wilmington, Del.—Davis brake-beam bar, solid truss, solid truss brake-beam with vertical strut, especially adapted to electric railroad service, solid truss high-speed brake-beam.

Dayton Manufacturing Co., The, Dayton, Ohio.—Car trimmings, brake handles, arc headlights, sash locks, incandescent headlights, Simmons-Moore sander.

Dearborn Drug & Chemical Works, Chicago, Ill.—Water-purifying preparations, lubricating oils and greases.

Dixon Crucible Co., Joseph, Jersey City, N. J.—Silica-graphite paint, pipe-joint compound, American graphite pencils, commutator compound, Ticonderoga flake graphite lubricants, graphite greases, plumbago crucibles, foundry facings, motor brushes.

Duff Manufacturing Co., The, Allegheny, Pa.—Barrett lever jacks, includ-

ing trip jacks, automatic lowering jacks and geared ratchet jacks. Barrett motor armature lifts, Duff roller-bearing screw jacks, Duff cone-bearing screw jacks, traversing jack bases.

Edwards Co., O. M., Syracuse, N. Y.—Models showing 25 designs of window fixtures and nine designs of extension trap-door fixtures, exhibit of tin barrel spring rollers, sash balances and window fixture hardware.

Electric Storage Battery Co., The, Philadelphia, Pa.—Two type R-cells—one containing 55 plates, the other 83; carbon regulator, compensating hydrometer, signaling hydrometer, recording hydrometer, automatic cell filler, several Manchester positive and box negative plates mounted on boards.

Fay, J. A., & Egan Co., Cincinnati.—Hollow chisel mortiser, special square column band saw, both electrically driven.

Felt & Tarant Manufacturing Co., Chicago, Ill.—Latest model "1907 Improved" Duplex comptometer.

Galena-Signal Oil Co., Franklin, Pa.—Samples of lubricating oils.

General Electric Co., Schenectady, N. Y.—Quadruple GEA-605 single-phase car equipment complete with type "M" control for operation on DC-AC circuits, mounted on frame and representing the under side of a car body, complete emergency straight-air brake equipment for motor car and similar equipment for trail car mounted on rack and operated together, GE-100 railroad motor; GE-80 railroad motor, operating exhibit of K28 and "F" controller arranged to show operation of contactors on rack, mercury arc rectifier outfit complete and operating incandescent lighting circuits of the exhibit space, portable air compressor outfit with CP-22 compressor, full exhibit of latest type catenary and standard direct-current overhead line railroad material, new type high candle-power Gem units and tantalum lamps, standard railroad supplies and line materials.

General Systems Co., Dayton, Ohio.—Egry system of train despatching. Egry system of railroad way-billing special systems devised for use in the operating, constructing and maintenance of the various departments of railroad service.

Gibbs Counting Machine Co., Zanesville, Ohio.—Counting machines for railroad offices.

Gold Car Heating & Lighting Co.—Gold's improved electric heaters for car heating and other purposes, panel heaters, riser-board heaters, cross-seat heaters, temperature-regulating devices, systems of hot-water circulation for use in interurban cars.

Goldschmidt Thermit Co., New York.—Thermit and appliances used in welding; also rare metals made by the alumino-thermic process; daily demonstrations of compromise joints.

Griffin Wheel Co., Chicago, Ill.—Car wheels.

Grip Nut Co., Chicago.—Grip-lock nuts.

Hale & Kilburn Manufacturing Co., Philadelphia.—Rattan in large rolls, also as a panel on three sides of exhibit, four styles of seats with pressed-steel seamless pedestals, small chairs used on private street cars and interurban cars, four steam railroad seats showing the latest design for street railroads which are similar but smaller.

Harrison Safety Boiler Works, Philadelphia, Pa.—Cochrane feed-water heater, Cochrane separator, framed photographs of Cochrane heaters and separators.

Heywood Bros. & Wakefield Co., Wakefield, Mass., and New York.—Interurban Wheeler car seat upholstered in green figured plush showing detachable back feature, Wheeler seat upholstered in rattan showing grab-handle and brass back-band, woven-rattan car seat webbing, section of Wheeler mechanism operated by electric motor.

Home Rubber Co., Trenton, N. J.—N. B. O. sheet packing valves, hose and tubular gaskets; O. I. M. high and low pressure diagonal rod packings, flax packings, hydraulic packing.

Indianapolis Switch & Frog Co., Springfield, Ohio.—Crossing of steam track with electric or interurban railway.

International Sprinkler Co., Philadelphia, Pa.—Complete exhibit of the devices entering into the construction of an automatic sprinkler system.

Jenkins Automatic Fender Co., Toronto.—Automatic fender.

Jewett Car Co., Newark, Ohio.—New semi-convertible car, one Brooklyn Rapid Transit car, one Winona Interurban 60-ft. combination passenger and smoker.

Johns-Manville Co., H. W., New York.—Overhead line material, third-rail insulators, asbestos transite doors for transformers, "Noark" enclosed fuses, blocks, service and subway boxes, car cut-out boxes, electric car heaters, trolley wheels and brass goods, transite asbestos for fireproofing electric cars.

Jones & Laughlin Steel Co., Pittsburg, Pa.—Cold-rolled axles.

Kalamazoo Railway Supply Co., Kalamazoo, Mich.—Root railroad spring snow scrapers, Root railroad spring fender, tower hand car, pressed steel wheels, ratchet jacks, friction jacks, three different styles of Moore track drills, Smith curve lining gage.

Kennicott Water Softener Co., Chicago.—Photographs and drawings of installations of water-softening plants.

Keystone Brake Shoe Co., New York.—Keystone brake-shoes and heads.

Kinnear Manufacturing Co., The, Columbus, Ohio.—Car-barn doors.

Kuhlman Car Co., Cleveland, Ohio.—Exhibit with J. G. Brill Co.

Lorain Steel Co., The, Philadelphia, Pa.—Special track work, girder and high tee-rails.

Lord Co., George W., Philadelphia, Pa.—Lord's boiler compounds.

Lumen Bearing Co., Buffalo, N. Y.—Axle bearings, truck bearings.

Magann Air Brake Co., Ltd., Detroit, Mich., and Toronto, Canada.—Motor and chain-drive tandem-compound air compressor with automatic starter and pressure regulator, floor framing of car with trucks, showing brakes in operation, automatic cut-off charging valve, hose couplings, rubber-seated ball check valve.

Massachusetts Chemical Co., Walpole, Mass.—Insulating specialties; Armalac, special Armalac, M. C. No. 50 insulating compound, M. C. waterproof paints, enameiac, cable and transformer waxes, friction tapes and splicing compounds, M. C. weatherproof tape, rubber-moulded specialties, field tape, field-coil cushions.

Masury & Son, John W., New York, Chicago, St. Louis, Minneapolis.—Panels decorated with seals of 11 States.

Matthews & Bro., W. N., St. Louis, Mo.—Stombaugh guy anchors, Kearney cable clamps, Lima jack boxes and plugs, O. K. sleet cutters, holdfast lamp guards, Hargis cable-splicing joints.

McGuire-Cummings Manufacturing Co., Chicago.—One Romunder single-truck semi-convertible car, a McGuire snow sweeper, solid steel Columbian truck, one No. 39-A, short wheel-base truck, one No. 10-A, M. C. B.-type truck.

Miller Anchor Co., Norwalk, Ohio.—Miller anchors, augers and hollow-stem tamping bars.

National Brake Co., Buffalo, N. Y.—Peacock brakes.

National Brake & Electric Co., Milwaukee, Wis.—Complete straight air-brake equipment, complete straight air-brake equipment with emergency feature, one new type air compressor, sectional air compressor, sectional slide valve, sectional emergency valve, supply parts for air-brake equipments.

National Car Wheel Co., Pittsburg, Pa.—Steel-tired wheels with cast-iron centers and cast-iron wheels for electric railroad service.

National Lock Washer Co., Newark, N. J.—Car window models showing operation of curtains equipped with National cam curtain fixture and National balance curtain fixture, with protected grooves. National sash locks, National sash balances and samples of National lock washers, plain nut locks and other patterns.

Newman Clock Co., Chicago.—Night watchman's clocks, employes' time recorders, electric signaling clocks and other new time-recording devices.

New York Switch & Crossing Co., Hoboken, N. J.—Special track work.

Nernst Lamp Co.—Exhibit with Westinghouse.

Niles Car & Manufacturing Co., Niles, Ohio.—Two 67-ft. cars for Columbus, Delaware & Marion Railway, one 53-ft. car for Aurora, Elgin & Chicago Railway.

Novelty Incandescent Lamp Co., Emporium and St. Marys, Pa.—Elk new incandescent lamps, Novelty renewed incandescent lamps.

Ohio Brass Co., Mansfield, Ohio.—Nichols-Lintern sanders, in operation on Christensen, Westinghouse and General Electric types of engineer's valves; Tomlinson car couplers; Alkman pressure annunciators; Armstrong journal oilers, headlights, hose bridges, bell-metal bearings, complete single-phase brackets, standard pole brackets, overhead material and all-wire rail bonds installed on rails and Lintern's electric marker and classification system.

Pantasote Leather Co., New York and Chicago.—Pantasote upholstery and car-curtain materials.

Peerless Rubber Manufacturing Co., New York.—Perfected air-brake, steam and pneumatic tool hose, Rainbow sheet packing, Peerless piston and valve-rod packing, Eclipse gaskets, trolley dodgers, rubber step mats, matting.

Pennsylvania Steel Co., Steelton, Pa., and Maryland Steel Co., Sparrows Point, Md.—Tee and girder rails, special track work, tongue switches, mates, frogs, split switches, switch-stands, crossings.

Perry Side Bearing Co., Chicago.—Roller side bearings for steam and interurban cars.

Peter Smith Heater Co., Detroit, Mich.—Hot-water heaters for electric cars.

Phillip Carey Manufacturing Co., Cincinnati, Ohio.—Carey's magnesia flexible cement roofing and all kinds of asbestos materials.

Pittsburg Steel Co., Pittsburg, Pa.—Electrically welded wire fence.

Power Specialty Co., New York.—Foster superheaters, Duval metallic packing, corrugated bronze gaskets.

Pressed Steel Car Co., Pittsburg, Pa.—Electric steel passenger car.

Quincy, Manchester, Sargent Co., Chicago, and Wallace Supply Co., Chicago.—Q. & C. Stanwood steps.

Rail Joint Co., New York.—Standard T-rail joints of the continuous, Weber and Wolhaupter types, girder joints of the continuous and Weber types, insulated joints of the Weber and continuous types, compromise joints of the continuous type and continuous joints showing their use with various types of bonds.

Ramapo Iron Works, Hilburn, N. Y., and Niagara Falls, N. Y.—Automatic return switch stands, split switches with patented solid-rolled steel riser plates, general track equipment.

Roebling's Sons Co., John A., Trenton, N. J.—Practical exhibition of application of rail bonds, car cables, electric wires and cables, armature and field coils.

Ryerson & Son, Joseph T., Chicago, New York, Pittsburg.—Working model of Continental boiler with Morrison corrugated furnaces, Ryerson portable automatic key-seating machine, Simplex car and track jacks.

St. Louis Car Wheel Co., St. Louis, Mo.—Chilled cast-iron street-car wheels (loose) for both local and interurban service, chilled cast-iron street-car wheels mounted on axles for interurban service.

Sherwin-Williams Co., Cleveland, Chicago, Montreal, Newark, London.—High-potential testing machines showing practice tests of insulating varnishes, exhibit of panels showing standard colors used by leading railroads, car-side exhibit showing the various coats as applied in Sherwin-Williams system of car painting, varnish exhibit, handcraft stain exhibit, pole paint exhibit, rattan seat exhibit.

Standard Brake Shoe Co., Aurora, Ill.—Steel-back brakeshoes, composition-inserted shoes, coil-inserted shoes, Congdon shoes, plain shoes of special brake-shoe mixture.

Standard Paint Co., The, New York.—P. & B. tape, electrical compound and insulating varnishes, Ruberoid roofing.

Standard Steel Works, Philadelphia, Pa.—Tires, cast iron spoke wheels, cast iron plate wheels, rolled steel wheels, rolled wheel, section cut-out, 33-in. cast iron plate wheel, M. C. B. section, M. C. B. motor axles, etchings illustrating cross sections of tire and rolled wheel, electric truck for Ocean Shore Railway Co.

Standard Varnish Works, New York.—Sections of field and transformer coils impregnated under vacuum with solid insulating compounds; solid compounds, both oil and waterproof, for use in connection with vacuum impregnating apparatus, voltalac and insulating varnishes.

State Manufacturing Co., Cleveland.—"Metla-Cota," a preparation for painting and coating the interior of water tubes and steam boilers.

Stephenson Car Co., Elizabeth, N. J.—Exhibit with J. G. Brill Co.

[illegible] Co., Pittsburg, Pa.—Insulating compounds.

Symington Co., T. H., Baltimore, Md.—Symington journal boxes for standard M. C. B. electric trucks of various designs, special journal boxes for special conditions, Baltimore ball-bearing center and side-bearings for electric service.

The International Fence & Fireproofing Co., Columbus, O.—American concrete mixers.

United States Metal & Manufacturing Co., New York.—Perfect car replacers, Victor car replacers, Columbia lock nuts.

Van Dorn Co., W. T., Chicago, Ill.—Automatic car couplings, draft riggings, model of steel box-car.

Van Dorn & Dutton Co., Van Dorn Elliott Electric Co., Cleveland, O.—Gears and pinions.

J. H. Wagenhorst & Co., Youngstown, O.—Machine for making blue prints by electricity.

Wallace Supply Co., Chicago and New York.—Wallace double-door fixtures, Stanwood steel steps, steel gongs, automatic couplers, draft rigging, bending tools (hand power).

Watson-Stillman Co., New York and Chicago.—Hydraulic railroad tools.

Westinghouse Companies, Pittsburg.—The apparatus displayed is that made by the Westinghouse Air Brake Co., Westinghouse Traction Brake Co., Westinghouse Automatic Air & Steam Coupler Co., American Brake Co., Westinghouse Electric & Manufacturing Co., Nernst Lamp Co., and Cooper-Hewitt Electric Co. The exhibit of the Westinghouse Air Brake Co. and Westinghouse Traction Brake Co. is composed of air brakes for light and heavy surface traction, also air brakes for elevated, underground and interurban traction. They also exhibit a blowing outfit for commercial purposes. The exhibit of the Westinghouse Automatic Air & Steam Coupler Co. consists of a working model of the automatic air and steam coupler. The American Brake Co.'s exhibit consists of various styles and sizes of brake slack adjusters. The Westinghouse Electric & Manufacturing Co. shows in operation a set of Westinghouse electro-pneumatic control, operating two No. 121 motors mounted in their trucks. The set also operates two motors mounted on one shaft and arranged with Prony brake, such as is used in factory tests. Display is made of stationary and portable instruments, wattmeters, voltmeters, ammeters, power factory meters, various kinds and sizes of both desk and ceiling fans; different designs of copper arc lamps; A. C. and D. C. railway motors of different horse power; high tension line material; also a number of separate armatures, fields and motor parts. The exhibit is lighted by Nernst lamps and Cooper-Hewitt lamp.

Western Electric Co., Chicago and New York.—General railway material. Electrose Manufacturing Co.'s line.

Wheel Truing Brake Shoe Co., Detroit, Mich.—Abrasive brakeshoes.

William Wharton, Jr., & Co., Philadelphia, Pa.—Manganese steel special track work of improved types, including switches, mates and frogs of "Easy Renewable" center construction, H. T. switches, both in girder and T-rail, solid Manganese steel girder-rail tongue switch, solid manganese steel tongue switches, mates and frogs of T-rail construction, Dunham spring throws and switch locks, Wharton unbroken main-line switch for trolley road; manganese steel funnel castings for bridge guides, manganese steel center steam crossings, manganese steel split switch, ground throws and switch stands as well as models of the Wharton switch for steam roads, U. M. L. derailing switch for street railways; section of a frog of "Easy Renewable" center construction, butt end of an H. T. switch, showing construction of same, besides enlarged photographs and black and white prints showing work furnished, worn manganese frog that has been in use in Broad Street Station, Pennsylvania railroad, for six years.

Wilson, Jas. G., Manufacturing Co., New York.—Rolling steel doors, rolling wood doors, sliding swing doors.

Yale & Towne Manufacturing Co., New York.—Electric hoists, chain blocks and trolleys.

Setting Line Stakes on Existing Railroad Curves by Middle Ordinates.

BY G. W. SNYDER,
Assistant Engineer, Pittsburg Division, Pennsylvania Railroad.

Those who are responsible for the maintenance of railroad tracks cannot always procure the services of the engineer corps when line stakes are needed. In the case of compound curves the results from the efforts of the corps are not always as satisfactory to the passenger as is desirable. The following method of setting stakes by middle ordinates was devised some six years ago. It has been thoroughly tested by a number of different persons since, and is now published for the information of those who may be disposed to try it.

Let A, B, C, D and E be five consecutive equi-distant points on a curve. Now, if the track is thrown outward at C the middle ordinate at that point will be increased by the distance thrown; while the middle ordinates at the adjacent points, B and D, will be diminished by half the distance C is thrown. If the track is thrown inward at C the effect is reversed; that is, the ordinate at C will be diminished by the throw and the ordinates at B and D increased by half the throw. The statements as to the ordinates at B and D may not be mathematically accurate, but the error is not material. A diagram will make this clearer.

If C is thrown to C′ the middle ordinate CX wil be increased by CC′.
If C is thrown to C′ the middle ordinates By and Dz will be diminished by ½ CC′.
If C is thrown to C″ the middle ordinate CX will be diminished by CC″.
If C is thrown to C″ the middle ordinates By and Dz will be increased by ½ CC″.

In short, having a list of stations and ordinates the effect of any throw that seems appropriate upon the ordinates affected can be written, and experiments on paper can be made until any desired variation in the ordinates shall be made.

The following process is suggested:

Measure the curve, making station marks on the rail, usually 50 ft. apart, carrying the stations out upon both tangents.

Measure the middle ordinate at each station using the chord between the two adjacent stations.

Tabulate the stations and ordinates.

Determine by inspection of the ordinates where the curve is flat or sharp. At the middle of each flat spot figure on throwing the track out as much as seems practicable or appropriate. At the middle of each sharp spot figure on throwing the track in as much as seems appropriate. Note the effects of the throws on the ordinates and continue the process until the ordinates are uniform or as nearly so as practicable. Then set a stake at each station with a tack so placed as to guide the track gang to throw the track the amount determined upon. Test the ordinates of the tacks and make any needed adjustments. Then have the track lined.

At first it will be found that a good deal of throwing—on paper—is necessary; and it will not be surprising if part of the track is so thrown, first out and then back again. However, such labor—on paper—is not very expensive, and practice greatly reduces it. Indeed, it is pretty well demonstrated by experience that

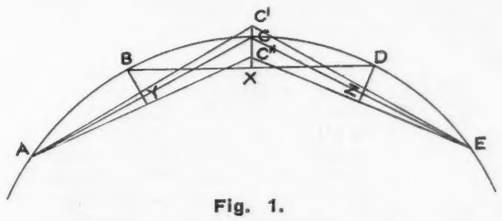


Fig. 1.

the method is very much cheaper than that of the engineer corps and just about as satisfactory to the passenger.

The following table will show what was done at the Red Bridge Curve, Altoona Yard, in September, 1900. The records had this a three-centered curve. It had been staked out by the corps. The results were not satisfactory. The application of the method of ordinates produced results that were satisfactory both from the aesthetic and utilitarian standpoints. The curve is now eliminated. The table indicates some quick estimating of the proper throws, but the original notes, now lost, did not look so well.

Columns 1 and 2 show the data taken on the ground. The figures in column 3 represent the application of experience and some mental arithmetic to those in column 2. Those in column 4 are the results of the application of the principle before explained to those of column 3. For example, as it has been decided to throw the track one-half an inch outward at Station 103 the increase of that amount in the ordinate at Station 103 and the simultaneous decreases in the ordinates at Stations 102 plus 50 and 103 plus 50 are noted opposite the stations. The form in which this is done has been found convenient by experience. Column 5 contains the algebraic sums of the figures in columns 2 and 4. Those who are not pretty expert at mental arithmetic may prefer to make it wider and note some of the partial results in order to better keep track of the experimentation. Column 6, the net throws, represents the algebraic sums of the figures in column 3. From column 6, the stakes are set—on one or the other side of the present center line as the case may be.

We had an interesting case a few years ago on a private siding flanked by buildings. The middle ordinates were very irregular and the curvature very sharp. Several derailments occurred on account of irregular curvature. The presence of a number of fixed points in the shape of corners of buildings made the curve the despair of the corps. The notes are lost, but the ordinates were

TABLE.

1	2.	3.		4.			5.	6.
Stations.	Original middle ordinates to 100 ft. centers.	Proposed throws		Effect of throws on ordinates			Final ordinates.	Net throw.
		+ out.	— in.					
102	0″	....	....	.....	.....	.....	0″	0
+50	½″	....	....	—¼	.....	.....	¼″	0
103	1¾″	+ ½	....	.....	+½	.....	2¼″	+ ½
+50	4″	...	....	—½ —¼	.....	—¼	3″	0
104	4¼″	+1 + ½	....	—⅞	+1 +½	....	4⅞″	+1½
+50	5¼″	+1⅜	....	—⅛ +⅝	+1¾	—½ —¼	6¾″	+1¾
105	8″	+ ¼	—1¼	+1¼	+ ¼ —1¼	—⅞	7⅜″	—1
+50	8¾″	....	—2½	+1¼	—2½	—⅛ +⅝	8″	—2½
106	8¼″	....	—2½	+1	—2½	+1¼	8″	—2½
+50	8¼″	....	—2	+ ½	—2	+1¼	8″	—2
107	8¼″	....	—1	—⅝	—1	+1	7⅜″	—1
+50	4¾″	+1¼	....	.....	+1¼	+ ½	6½″	+1¼
108	6″	....	....	—¼	.....	—⅝	5⅛″	0
+50	4½″	+ ½	....	—¼	+½	....	4¾″	+ ½
109	4½″	+ ½	....	.....	+ ½	—¼	4¾″	+ ½
+50	5″	....	....	+ ¼	.....	—¼	4¾″	0
110	5¼″	....	—⅛	— ¼	—¼	.....	4⅞″	—⅛
+50	4½″	+ ¼	....	.....	+ ¼	+⅜	4⅞″	+ ⅛
111	5″	....	....	— ⅛	.....	— ⅛	4¾″	0
+50	4½″	+ ¼	....	.....	+ ⅛	.....	4¾″	+ ⅛
112	5¼″	....	....	— ⅝	.....	— ⅛	4¾″	0
+50	2½″	+ ¾	....	— ¼	+ ¾	.....	3″	+ ¾
113	⅝″	+ ½	....	.....	+ ½	— ¾	⅞″	+ ½
+50	½″	....	....	.....	.....	— ¼	¼″	0
114	0″	....	....	.....	.....	.....	0″	0

Fig. 2.

made pretty regular without interference with the clearance by a throw not over ten inches. After the siding had been thrown to the stakes, there was no further trouble.

Be sure to test the ordinates of the tacks before leaving the stakes.

Automatic Signals on P., B. & W.

"The very latest" would seem to be the proper designation of the new electro-pneumatic automatic block signals which have just been put in service on the Central division of the Philadelphia, Baltimore & Washington (Pennsylvania Railroad system) from a point near West Philadelphia to Morton, Pa., 8¼ miles. Every signal post has two blades. All are three-position and the proceed indication is given by inclining the blade upward from the horizontal. The two lamps on an automatic signal post are staggered, one being on one side of the post and the other on the other, and the interlocking signals are all so arranged as to indicate three speeds.

This installation has been under construction for several months, under the direct supervision of Mr. A. H. Rudd, Assistant Signal Engineer, and the signals were put into service on September 26.

The line is double tracked, and there are 22 block sections, making the average length of sections about 4,000 ft. There is only one interlocking within the signaled territory. This is at Morton and is a mechanical machine with electro-pneumatic signals. All interlocking signals in the main line are so controlled by the relays of the track circuit that the signals always go to the stop position when a train or engine passes them in the normal direction, the signals thus being semi-automatic. Two of the automatic block signals are controlled from telegraph offices, so as to be used as train order signals but all of the others are simple automatic block signals.

Each interlocking signal has two full size blades, one 6 ft. below the other, and one small blade 12 ft. below the lower full size blade; thus provision is made for full speed on a main line; for a limited speed, as through a No. 20 cross-over, and a speed under full control, as in entering a side track. Any blade in such a signal for which there is no route is fixed in the stop position. The signal posts are of iron, tubular, with the connections to the

blades inside the posts. On interlocking and train order signals the lamps are fixed one above another as in ordinary practice, but on the automatic signals they are staggered, as before stated. These lamps are 6 ft. apart, measured vertically, and 2 ft. apart measured horizontally. The compressed air is conveyed from the compressor at Media through a 2½-in. pipe. In emergencies air pressure can be supplied from West Philadelphia. Batteries for most of the automatic signals are kept in the bases of the signal posts, but at three places they are in boxes on signal bridges. Isolated switches, when turned off from the main track shunt the track circuit by means of a switch box in the usual manner. In connection with each switch there is a derail in the side track, this and the switch being moved by a single lever.

At cross-overs both switches are worked by one lever through a switch and lock movement. This lever must be locked before the signal for that section can go to the clear position, and the lever is fixed in the middle of the track of the cross-over so that in case an engine is standing on the cross-over its presence will make it impossible to get at the lever to move the switch.

The relays are 5-ohm universal polarized type.

The track circuits are worked by storage batteries, as are also the controlling circuits of the signals themselves. The batteries are charged in series from the power plant at Media, through a No. 6 copper line extending throughout the signaled territory, and by means of a 500-volt generator, as has been the custom on Pennsylvania Railroad signal work for several years past. The voltage is about 500, and the effective charging current about 5 amperes.

The night color indications in these signals conform to the Pennsylvania standard; white for proceed, green for caution or distant and red for stop. In the automatic signals the upper blade works precisely as on the Fort Wayne and other roads where the three-position signal has been used. On the passage of a train the blade goes to the stop position; on the passage of the rear of the train out of that block section the blade takes the 45-degree position (upward), and when the train clears the second block in advance, the blade goes to the 90-degree position (vertical, upward). The lower blade on an automatic signal, which is a "dummy," fixed in the horizontal position, has a light always showing red.

The signal material and apparatus, except the wire and pipe, were furnished by the Union Switch & Signal Company, Swissvale, Pa.

The Grand Trunk Station at Battle Creek.

The new passenger station of the Grand Trunk at Battle Creek, Mich., occupies the whole block fronting on East Hill street, between East Main and Beach streets. The walls of the building are of Maine granite and the roofs are made of semi-glazed red Spanish tile. On the first story is the entrance lobby, general waiting room, smoking room and ladies' parlor. In the southeast corner is the lunch room, with a capacity of 50 persons, and in the northeast corner the baggage room. The express building is 200 ft. from the main building, with which it is connected by a wide veranda. On the second story of the main building are offices. The platforms and walks are all concrete. The floor of the waiting room is of mosaic tile, and the walls are wainscoted 9 ft. high with ivory enameled tile, above which is a gilt frieze. This room is two stories high and the ceiling is vaulted with groined arches. The station was built by Lewis & Sons, Battle Creek, and the architects were Spier & Rohms, Detroit, Mich.

New Grand Trunk Passenger Station at Battle Creek, Michigan.

Steel Passenger Cars Built by the Pressed Steel Car Company

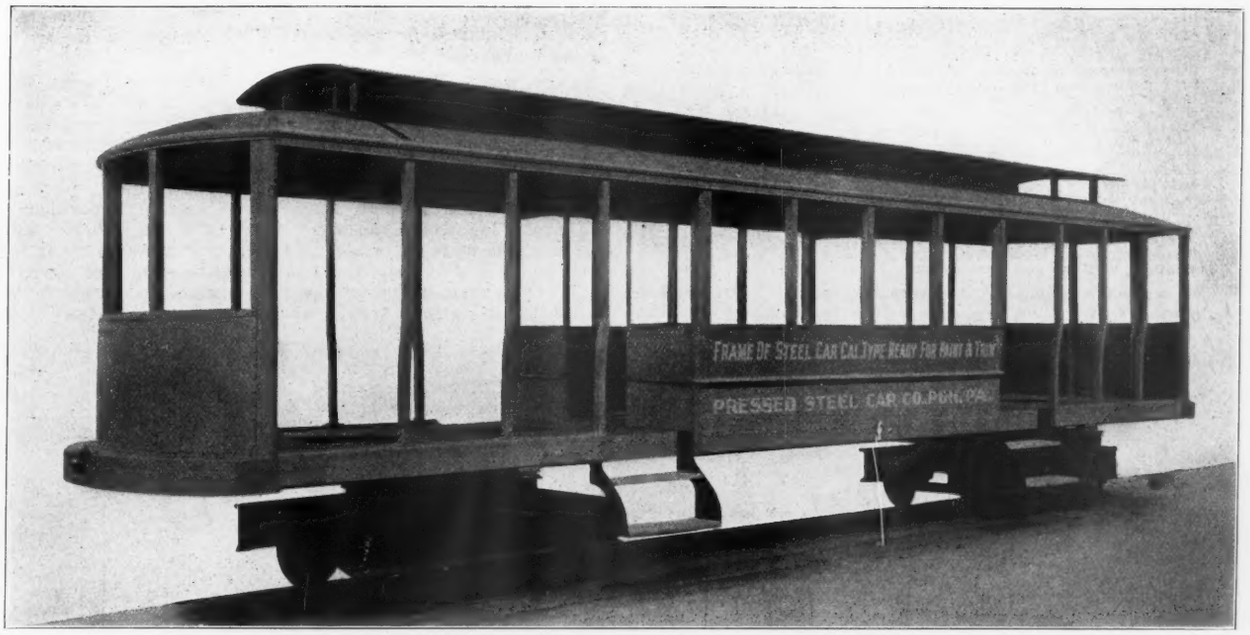
In the spring of 1905 the Pressed Steel Car Company, of Pittsburg, announced that it would build a plant to be devoted exclusively to building steel passenger cars for both steam and electric railroads. Since that time work has been pushed on the new buildings. Contracts for all-steel passenger cars covering several months' operation of the plant have already been taken. The first car turned out at the new plant was completed early this year for the United Railways of San Francisco—an all-steel street car of the "California" type. The aim has been to preserve the external contour and general inside and outside appearance of the wooden passenger car, at the same time building the car for the greater part of steel plates, pressed shapes and commercial sections. This form of construction gives rigidity, which means resistance in collisions with lightness. It has been possible to build cars of this sort which, with dimensions corresponding to wooden cars of the same type, are difficult to distinguish from the wooden cars. In carrying out this idea the rivets on the outside of the car body are covered with special drawn moldings and all steel parts and the steel posts, panels, etc., are grained to conform to ordinary wood finish. The "California" type of car is one adapted to the climatic conditions of that state. It has open sections at each end with a closed section in the middle, thus forming an arrangement suited for service the year round. The accompanying photograph gives a general view of the framing of the car and the general dimensions are as follows:

Seating capacity	40
Length over all	40 ft. 6 in.
Length over closed part of car	13 " 2 "
Distance from center to center of trucks	23 " 6 "
Width over side sills	7 " 10½
Width over side sheets at belt rail	8 " 2¼
Height from top of rail to top of roof	11 " 5½

The underframe and side sheets together with the outside finish up to the eaves of the closed section of the car and the platform posts on the open sections are made of rolled or pressed steel plates. The doors, window sashes, floor mats and deck moldings are wood. The floor is $^{3}/_{32}$ in. steel plate, with one course of wood above. The lower and upper deck ceilings are made of steel sheets. The carlines and purlins are of rolled angles and the center sills are 6-in. channels. The side sill is built of Z bars and pressed angle plates, and the bumper is made of 8-in. rolled channel, pressed to shape. In order to carry the weight of the car entirely on the side it was necessary to provide openings for the steps between the trucks next to the closed car section without weakening the car at these points. This was done by placing reinforcing angles, extending past the body bolster, alongside of the openings for the steps. In the closed part of the car the longitudinal seat supports are built up of steel plates and angles. The body bolsters are steel trusses to be used with Peckham trucks having 33-in. wheels. The car is fitted with Wood's patent standard gates; in the open part of the car with "Walkover" cross seats, and in the closed part with longitudinal rattan seats and backs.

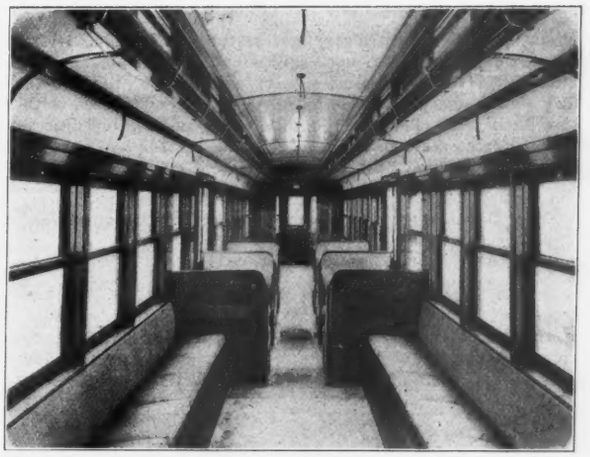
After this "California" car, the next ones built in the new plant were three passenger cars now being used on the Southern Railway and 40 all-steel passenger car bodies, most of which have been built for the Philadelphia Rapid Transit. The car for the Southern Railway was exhibited at the Atlantic City conventions in June and illustrated in the *Railroad Gazette* on June 22, 1906. The framing of the car is of steel throughout; the vestibules are of steel and the outside sheathing up to the window rail is made of steel plate. To meet the wishes of the railroad company wood finish was used above the window rail.

The cars for the Philadelphia Rapid Transit are to be used on the Market street elevated and subway. They are illustrated in the accompanying photographs. These cars are of steel throughout with non-combustible flooring composition, making them practically collision and fire proof. The outside sheathing is of cold rolled steel and the underframe is made up of deep, fishbelly side sills, with cross-bear-

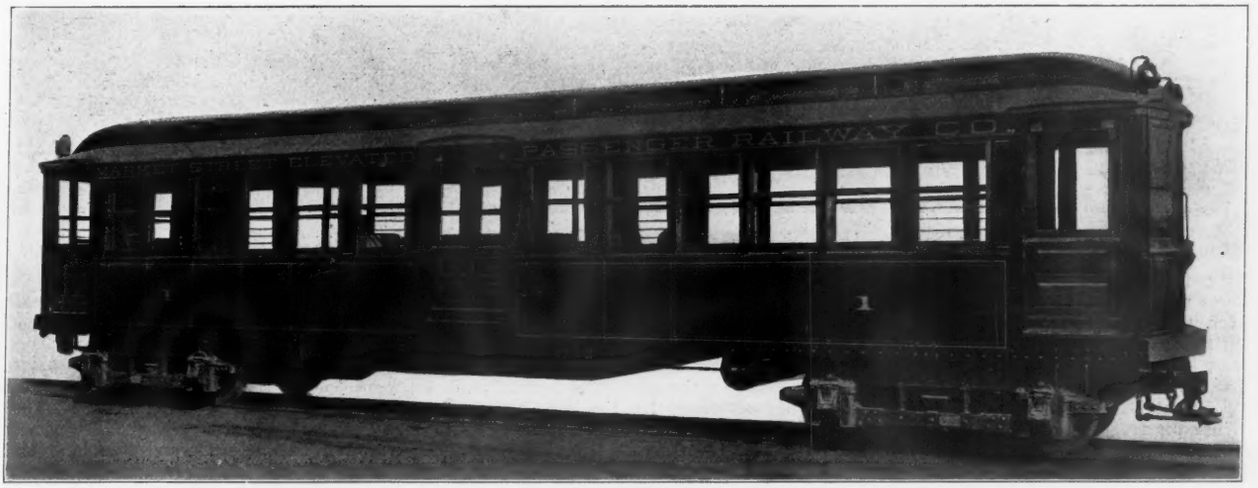


Skeleton Body Framing for "California" Type Street Car, United Railroads of San Francisco.

Interior of Southern Railway Steel Passenger Coach.



Interior of Philadelphia Rapid Transit Steel Car.

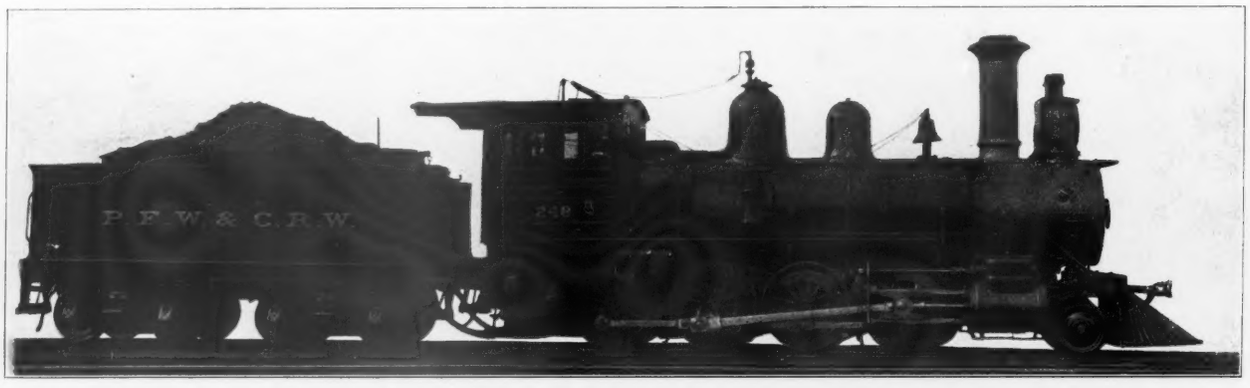


Steel Car for Market Street Elevated and Subway, Philadelphia Rapid Transit Co.

ers and connections in girder form. The general dimensions of these cars are as follows:

Seating capacity	52
Length over all	49 ft. 7¼ in.
Length over door posts	40 " 6¼ "
Length inside of car (end line)	39 " 6¼ "
Distance from center to center of trucks	34 " 6 "
Width outside side sheets	8 " 7 "
Width inside	7 " 7¾ "
Height from rail to top of floor	3 "10 "
Height from floor to ceiling-center	8 " 6½ "
Height of rail from top	12 " 7 "
Opening bet. door posts for vestibule side-door	2 " 9 "
Width of opening for end door	3 " 2½ "
Width of side opening for center door	3 " 4 "
Width over eaves, upper deck	5 " 6¾ "
Width over eaves, lower deck	8 " 8⅝ "
Width of vestibule and door opening	2 ft.

The cars have automatic air-brakes with automatic air couplers; the side and center doors are arranged for opening and closing by pneumatic devices from either end of the car. The underframe is covered with corrugated steel sheets and Monolithic flooring composition. On the right-hand side of each end of the car there is a motorman's cab. The roof is of ½-in. poplar covered with 8 oz. cotton duck. There are four longitudinal seats holding nine persons and eight cross seats in the center of the car for two persons each. The cars are painted Tuscan red, with gold stripes.



Consolidation Freight Locomotive of 1880, Pennsylvania Lines West.

The Development of American Freight Locomotives.

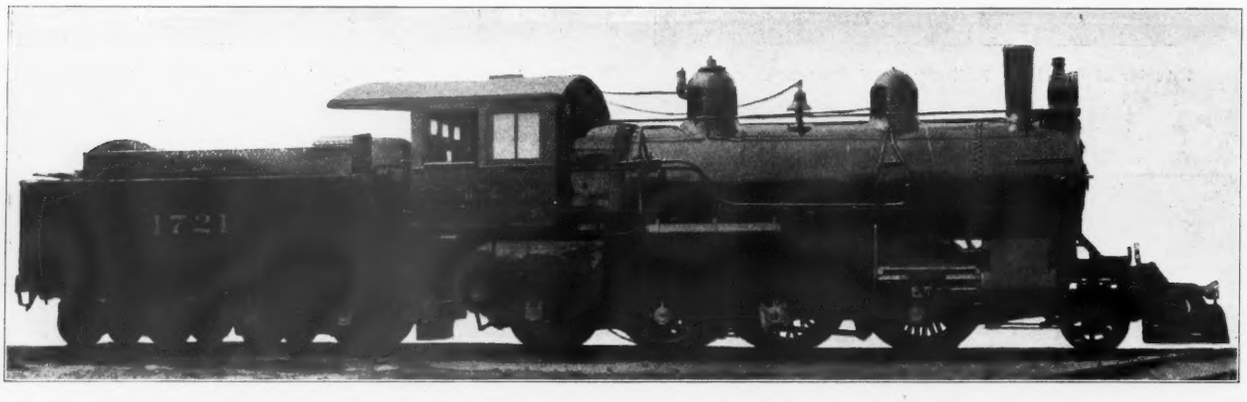
BY GEO. L. FOWLER.

In the previous article on the development of the American passenger locomotive that appeared in the *Railroad Gazette*, June 15, 1906, an outline was given of the work that had been done by which the capacity of the passenger locomotive had been increased three-fold. The progress in freight locomotive construction was along much the same lines. There was the same lifting of the boiler and placing of the mud ring on the top of the frames; and, later, the widening of the firebox and the introduction of a trailing truck to carry it. The service demanded from freight locomotives is so different from that demanded of passenger locomotives that, of course, there have been some variations between the two.

Twenty-five years ago there were three types of locomotives in use for freight service on American railroads. These were the American, or eight-wheel type, which, with the exception of a difference in the diameter of the driving wheels was similar to the same type as used for passenger work; the mogul and the consolidation. It may be remarked here that many of the names now used technically to describe certain features on, or types of locomotives, originated in a nickname given by the men in the shop or the roundhouse.

The mogul locomotive, or, according to the present Whyte nomenclature, the 2-6-0 type, had a pony truck with a single pair of wheels in front followed by three pairs of driving wheels. The consolidation had the same arrangement of pony truck with four pairs of driving wheels. In 1880 these two types of locomotives were rapidly coming into general use. The cylinders were small and the locomotives were comparatively light. The cylinders of the mogul locomotives averaged about 17 in. in diameter with a piston stroke of 24 in., while the boilers had fireboxes about 35 in. wide and 5 ft. 6 in. long, and a total heating surface of about 1,200 sq. ft. The total weight of these locomotives was from 75,000 to 80,000 lbs., of which 65,000 lbs. were on the driving wheels.

The consolidation locomotives were heavier and had an average cylinder diameter of 18 or 19 in., though as early as 1876 some locomotives of this type were built for the Pennsylvania Railroad with cylinders 20 in. in diameter and a total weight of 114,000 lbs., of which 100,000 lbs. were on the drivers. These locomotives had a firebox 42⅞ in. wide and 8 ft. 7⅝ in. long, and the total heating surface was 1,871 sq. ft. They were, however, exceptional for the time and far in advance of the practice on a majority of roads. All through the discussions of the Master Mechanics' Association during this period, one can read the underlying doubt and hesitation as to the advisability of using the mogul and consolidation locomotives, and it was well along in the eighties before their position was firmly established. In 1879 the *Railroad Gazette* referred to the mogul as "a type which is now coming into such general use." As to which was the better for level roads, there was also doubt, and it was only after years of service in which it was demonstrated beyond all question that the heavy locomotive was suited for the long hauls of through traffic, that the consolidation won its spurs and came to be the acknowledged standard for freight work. Meanwhile, as in the case of the passenger locomotives the cylinders crowded the boiler capacity until the introduction of the Class K locomotives in passenger service on the Pennsylvania Railroad opened the way for a wide firebox and greater boiler capacity.



Prairie Type Freight Locomotive, Chicago, Burlington & Quincy.

From 1880 to 1900 there were spasmodic increases of size to meet special conditions, and the record was repeatedly broken. For example, in 1882 a 12-wheeled locomotive was built for the Central Pacific which, at that time, was the largest and heaviest locomotive in the United States and probably in the world. It had

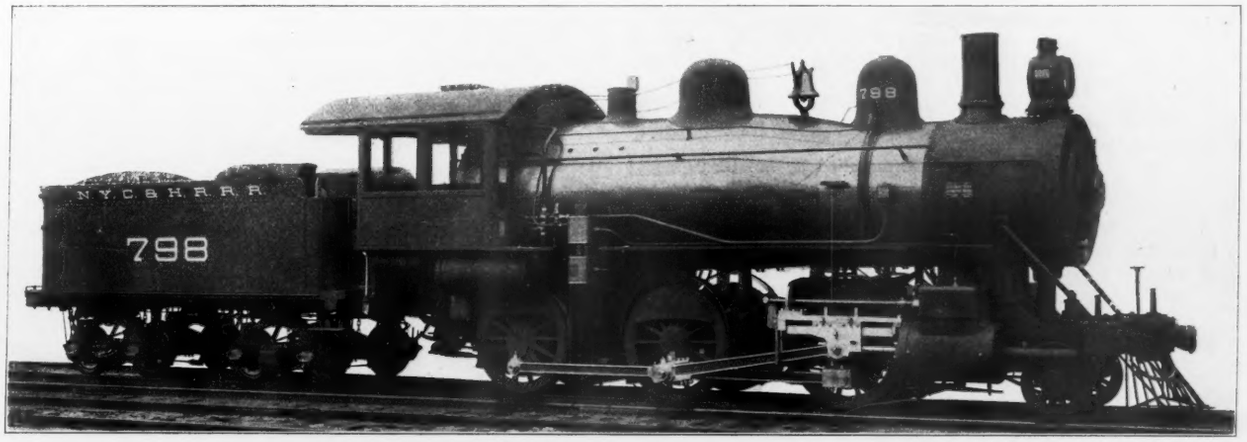
cylinders 19 in. in diameter, with a piston stroke of 30 in., and weighed 123,000 lbs., of which 106,500 lbs. were on the driving wheels. For the times this was excessive weight and high cylinder capacity, but the heating surface was only 1,258 sq. ft., an amount sufficient, however, for the slow speeds at which the locomotive was worked on grades of about 2¼ per cent. Such variations from accepted standards were of frequent occurrence in early American practice and serve, in a way, to indicate what usually followed provided the experiment proved to be a success.

In 1882 the most advanced general practice was that presented by the Pennsylvania Railroad in what is now known as the H3a class. This was a consolidation locomotive having cylinders 20 in. in diameter with a piston stroke of 24 in.; a boiler with 1,498 sq. ft. of heating surface and a total weight in working order of 128,740 lbs., of which 112,610 lbs. were on the driving wheels.

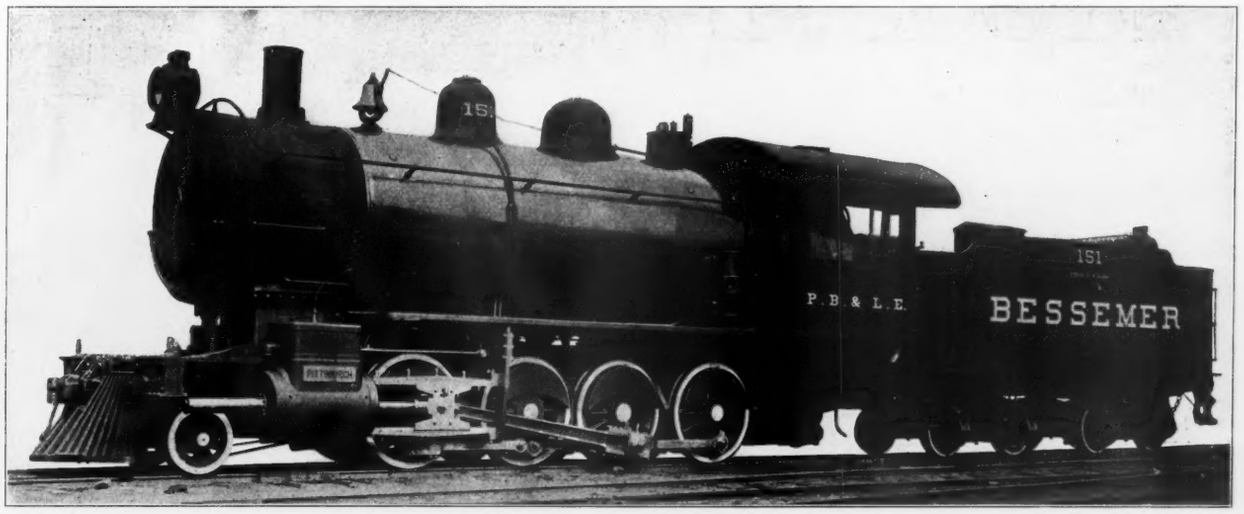
Since that time the size of cylinders and the weights of locomotives for general road service have not been increased in anything like the ratio that has obtained in passenger service. Heavy freight locomotives of the present day have cylinders 22 in. in diameter, with a piston stroke of 28 in.; a total heating surface of from 2,500 to 2,600 sq. ft., and a total weight of 174,000 lbs., of which about 156,000 lbs. are on the drivers.

It has, however, become a common practice on all of the main lines, especially where there are heavy grades, to use engines of special design or size for working in such places. An example of this is the consolidation locomotive built by the American Locomotive Co., Pittsburg Works, in 1900 for the Pittsburg, Bessemer & Lake Erie, which had cylinders 24 in. in diameter, with a piston stroke of 32 in., a heating surface of 3,805 sq. ft. and a weight of 250,300 lbs., of which 225,200 lbs. was on the drivers. This locomotive was designed for hauling ore trains from the wharves at Conneaut Harbor, on Lake Erie, up a grade of 0.14 per cent. for a distance of 14¾ miles. The trains regularly hauled in this service consist of 36 loaded cars of 50 tons capacity, with a 10 per cent. overload, so that the total weight behind the tender amounts to about 2,600 tons. Such a load is too much even for these monsters, and they are assisted by a 10-wheel pusher, weighing about 140,000 lbs. At the top of the grade the train is taken by the regular road locomotive. Large as these locomotives are they were exceeded by some compounds built later for the Atchison, Topeka & Santa Fe, known as the Santa Fe type.

Within the past four or five years the high tractive power required and the great weights needed have led designers to adopt for freight locomotives the wide firebox and trailing truck to carry a part of the weight, a design so successfully employed in passenger service in locomotives of the Atlantic and the similar types. This modification has produced the Prairie or 2-6-2 type, the Calumet or 2-8-2 type, and the Santa Fe or 2-10-2 type. The first is a mogul with the trailer truck added. The second holds the same relationship to the consolidation, while the last is the old decapod with the same addition. Naturally, as the number of driving wheels are increased the weight increases also, and usually the total amount of additional weight is carried on the drivers, that on the two trucks remaining approximately the same. On the other hand, the addition of the trailing truck to any of the older types has not usually involved any increase of weight on the drivers, but the change has been made in order to obtain a larger boiler than would otherwise be possible.



Mogul Freight Locomotive, New York Central & Hudson River.



Heavy Consolidation Freight Locomotive, Bessemer & Lake Erie.

We thus find the Prairie type, brought out in 1900, having cylinders 19 in. in diameter with a piston stroke of 24 in., with 1,950 sq. ft. of heating surface and a total weight of 138,000 lbs., of which 94,000 lbs. were on the drivers. This does not differ essentially from the moguls of the same date with the exception of the heating surface. These locomotives were intended for service where the capacity of the boiler governs the load hauled, and were first used on the Chicago, Burlington & Quincy on lines where the grades were low, in heavy freight service at slow speeds or in high-speed stock trains.

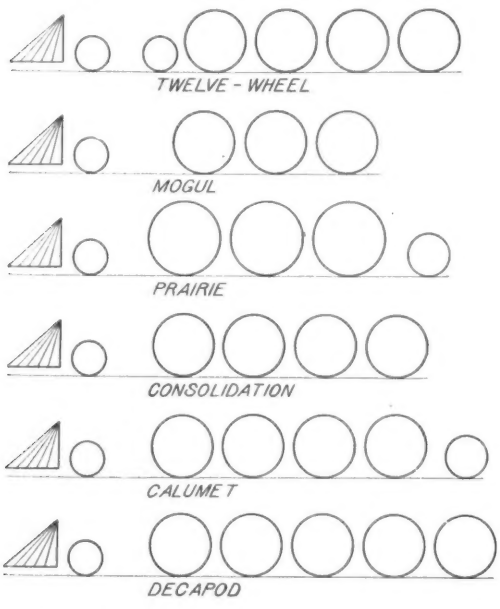
Where the work to be done has exceeded the possible tractive power of the consolidation locomotive even with the heavy driving

wheel weights now imposed, the decapod has been resorted to. But this only for special service, and the type cannot, as yet, be regarded as a typical road locomotive.

Perhaps the most striking example of the growth of the American freight locomotive in the matter of weight is afforded by the history of the Kinzua viaduct. This viaduct, at the time of its construction in 1882, was the highest and longest in the world. The rails were laid 301 ft. above the stream surface in the valley below and it was 2,053 ft. long between abutments. It is on one of the spurs of the Erie Railroad south of Bradford, Pa., and was originally designed and built to carry, with an ample factor of safety, a continuous train of the heavy consolidation locomotives of the time reaching from end to end; locomotives that weighed 103,400 lbs., with 88,700 lbs. on the driving wheels. In 1898, inspection showed that the structure had not deteriorated in strength in any way, and yet it was torn down to its foundations and replaced by another structure capable of sustaining the heavy traffic of to-day, for which the original viaduct was no longer suited; a traffic in which trains consisting of cars of 100,000 lbs. capacity are hauled by consolidation locomotives weighing 190,000 lbs., of which 170,000 lbs. are on the drivers.

This growth in size has been accompanied by modifications of practice all along the line, to touch upon all of which would be quite impossible. In order, however, to give some idea of the way in which the work has developed, two details will be treated briefly, the boiler and the frames.

It was shown in the previous article how the steam pressure



Wheel Arrangements of Modern Types of American Freight Locomotives.

in passenger locomotives has risen from 125 to more than 200 lbs. per sq. in., with an average of about 180 lbs. The same holds true for freight locomotives, and this increase has naturally called for a corresponding improvement in boiler practice.

It may not be greatly to the credit of the former railroad officers, but it is well within the truth to say that the boilers of the seventies were not designed but were built, for the most part, along lines that had been found to "do." Horizontal seams were of the lap joint type with two rows of rivets at the most, and frequently with only one. Grooving was a common source of trouble, and on the majority of roads the reason was not even guessed. In fact, as late as 1882 the President of the Master Mechanics' Association thought it necessary to show by diagrams to the convention how the bending of the common lap seam, when at work, would tend to produce grooving.

At the same convention a report on boilers was presented in which it was said that:

"Our English friends are far ahead of us in the strength of their boilers. We think they go to the extreme in using butt joints, outside and inside welt pieces, drilling and reaming all rivet holes, . . . and perhaps to a certain extent they do, yet I am satisfied that if we imitated them a little nearer . . . it would be a paying investment in the matter of durability and lessening the cost of repairs.'

This opinion gained credence rapidly after 1879 and the use of welt seams soon became universal.

Closely allied with this improvement is the change from hand to machine riveting. Of course, in the building shops, machine riveting for the shells was in use long prior to the period under consideration. But, in the railroad shops, the deep gap riveter was almost unknown and all work was done by hand. The increase in thickness of the sheets from ⅜ in. to ⅞ in. called for work entirely beyond the capacity of the hand hammer and the pneumatic riveting hammer has taken its place at all points except where the gap riveter is available. Inside and outside welts with sextuple riveting is the accepted practice for all horizontal seams and the circumferential seams are always double riveted.

The old crownbar method of holding the crownsheet has gone out of use and in its stead has come the radial stay or the Belpaire type. Radial staying, however, may be regarded as the standard practice, the general use of the Belpaire boiler being confined principally to the Pennsylvania Railroad, though there are scattering and increasing exceptions.

Staybolts and interior bracing have been subjected to a wide range of experiments with the result that the screwed bolt cut away at the center on an easy curve so as to distribute the bending strain evenly throughout its whole length has met with the widest approval. Flexible staybolts are also extensively used.

In the case of frames, to the casual observer, the frame of to-day would seem to be exactly like that of 25 years ago except in the matter of size. It consists of two bars, the upper one nearly

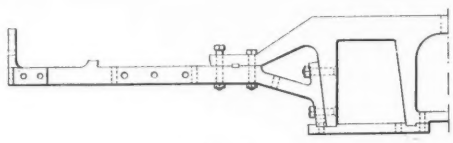


Fig. 1.

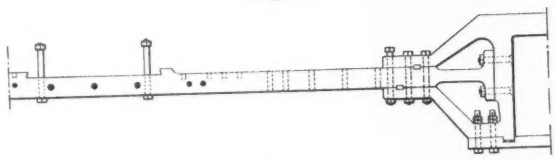


Fig. 2.

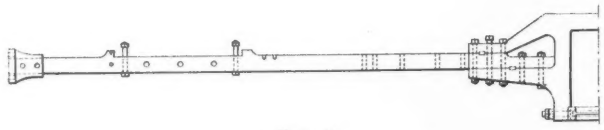


Fig. 3.

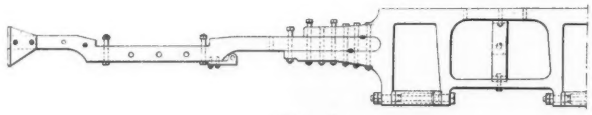


Fig. 4.

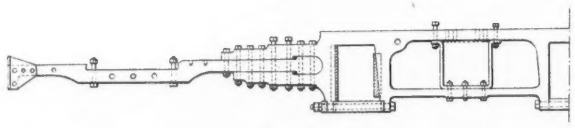


Fig. 5.

square and the lower one of the same width as the upper but narrower in vertical dimensions. These frames have always been made in two pieces, the back part containing the pedestals for carrying the axle boxes, and the front rail or rails to which the cylinders are fastened.

It is at the splice between these two pieces that the study for improvement has been directed. This was brought out by Mr. Vauclain, of the Baldwin Locomotive Works, in an address before the New York Railroad Club sometime ago. In order to show how these details have been worked out step by step a series of illustrations are given showing the various changes in detail that have been made in the development of the fastening.

Fig. 1 is the type of fastening used in the late seventies. The frame was of wrought iron, and the front rail was joined to the main frame by a T foot whose upper arm was jumped on and held by countersunk bolts. All welds were made by hand and the work was correspondingly expensive. In addition to the countersunk bolts through the pedestal, there were two vertical bolts holding the front rail to the drop of the main frame, and these bolts were supposed to be relieved of shear by the key that is shown between them. With the small cylinders in use at that time this frame gave little trouble, but with an increase in the diameter of the cylinders the repeated stresses would draw the countersunk bolts

down and the nuts would come loose. Then the side pull would tend to turn the key and the vertical bolts would be sheared off.

This form was followed by that shown in Fig. 2, wherein the front rail ran between two arms of the main frame and ended in a T foot held as before. Again these countersunk bolts gave trouble by breaking, because the whole load would be carried by them in consequence of the springing of the two parts of the main frame.

This construction was abandoned for that shown in Fig. 3, in which the lower portion was raised and made horizontal with the front rail laid flat upon it and held by bolts; some of which went through the upper section of the frame, to which a key was added. This form gave excellent satisfaction, with cylinders up to 18 in. diameter.

Heavier engines, however, required a stronger fastening, and a direct outgrowth of the form shown in Fig. 3 is that shown in Fig. 4, in which both upper and lower jaws of the main frame are horizontal, with the front rail between them and having a key on each side. This gave excellent service for a time but again the increase in cylinder dimensions necessitated a change. The keys, which had but a half bearing in each of the two parts between which they were placed, would twist and throw the entire stress upon the bolts. To obviate this trouble the lower frame was given a T head, as in Fig. 5, and keyed against the lips on the arms of the main frame.

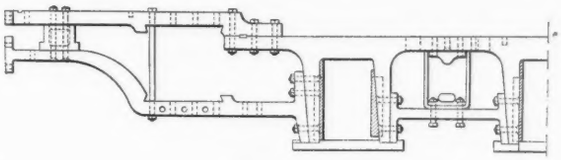


Fig. 6.

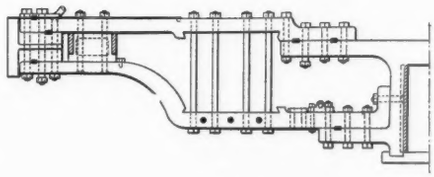


Fig. 7.

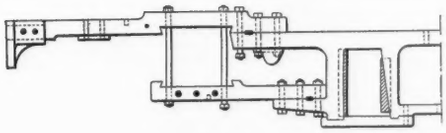


Fig. 8.

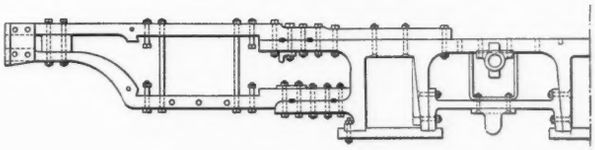


Fig. 9.

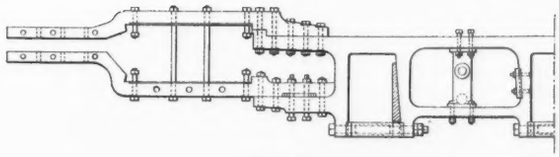


Fig. 10.

Where double rails were used they were at first attached, as shown in Fig. 6, in which the lower rail had the same T head as in Fig. 1, while the upper rail was simply laid on and bolted to an extension of the upper frame. It was the standard method of construction for many years, and the only trouble experienced with it was an occasional breaking off of a T head.

When this method of fastening became too weak for the increasing diameter of cylinders, the lower arm was made horizontal, but an upward bend of the front rail still left an opportunity to use the countersunk bolt through the pedestal leg, as shown in Fig. 7. This form was short lived and yielded to that shown in Fig. 8, in which the T head was dispensed with and the front lower rail laid on like the upper one and bolted fast. This, in turn, gave way to that shown in Fig. 9, in which the upper front rail was extended back over the jaw of the forward axle, while the upper arm of the main frame was run out to abut against the cylinder casting. The lower arm was lipped up into the lower rail so as to form a bearing there for all back thrust of the cylinders.

This in turn was followed by that shown in Fig. 10, in which the front upper rail was lipped down over the upper arm of the main frame, as in the case of the single rail frame of Fig. 5. Strong as this construction was, the stresses imposed by the cylinders were too great and, on the latest type of heavy engines, we find the form shown in Fig. 11 in use. Here the two front rails have been united in a single deep slab, to which the cylinders are bolted. These parts are no longer cast solid with a half saddle but are separate with a saddle between. The first frames of this sort that were built had the fastenings to the main frame as in Fig. 11, but they have been followed by that of Fig. 12, in which the upper rail has been carried back over the top of the jaws and keyed as shown.

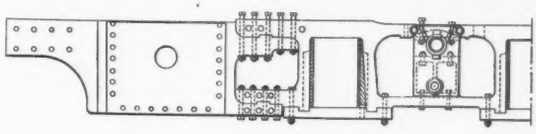


Fig. 11.

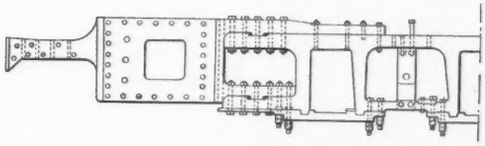


Fig. 12.

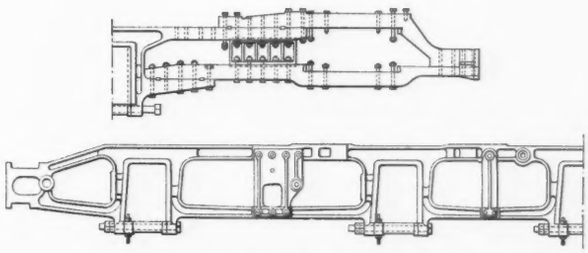


Fig. 13—Cast Steel Locomotive Frame.

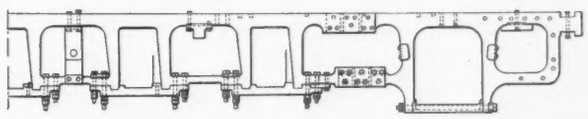


Fig. 14.

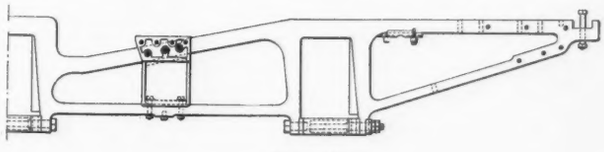


Fig. 15.

During all this period of development there has been more or less activity in attempting to produce a cast-steel frame. First efforts were not altogether successful, but the desirability of securing such a frame, on account of the facility with which provision could be made for the attachments, together with the probable decrease in the cost of machining encouraged makers to persist in the work until now cast-steel frames like that shown in Fig. 13 are made, which can be made complete for less than the cost of finishing a frame of the older type. The result is that, though these frames are far from having come into general use, they may be considered to represent the latest type of the frame of the American locomotive.

But a word need be said regarding the back part of the frame. It has changed but little in form. That of the early engines is shown in Fig. 14, and this still holds with such modifications as may be required to accommodate the trailing truck of the later

classes of engines or to add to the depth of the firebox by the use of the drop in the upper rail, as shown in Fig. 15.

From what has been said it will be readily understood that it is quite impossible to deal even with equal brevity upon all points in the locomotives that have been subjected to this critical handling and remodeling during the past quarter of a century, but enough has been said in this connection to show the tremendous amount of tentative work that has been required in order to develop the locomotive to its present condition, and the end is not yet.

Metal Cross Ties.*

During the fall of 1900 there was furnished to the Bessemer & Lake Erie about 1,100 steel ties; these were the Carnegie M-14 trough section. During November and December about 750 intermediate ties were placed south of Osgood under 100-lb. rails, where the alinement was a compound curve of 6 deg. 30 min., reducing to 3 deg. 30 min., followed by a 9 deg. reverse curve. During the following March and April, after the slotted angle bars were received, the joint ties were put in. The track was then ballasted in the usual manner with furnace slag. About one-half of these ties had an angle riveted on the under side at the center, and the balance had an angle riveted on the under side just outside of each rail. The object of the angle was to hold the track in line. They caused some inconvenience in the final lining of the track after it was surfaced. At the time the ties were put in all trains ran over this track, but after May 1, 1902, southbound ore trains and a portion of northbound freights were handled over a new line running to the east, but the rest of the trains continued using this track. Trains were operated over the 9 deg. curve about four years without resurfacing. On account of the soft roadbed, portions of the compound curve did not run so long. These ties are still in and are giving good service, but are not as satisfactory as those used since.

During September, 1904, there were received about 1,200 Carnegie I-beam steel ties. During November and December, 1904, and January, 1905, 1,000 of these were put in the track about two miles north of Euclid station, where the track was laid with 100-lb. rails on white oak ties about six years old and ballasted with 6 or 8 in. of slag. The ties were put in by the regular section gang and without any special provision for placing track in better condition than it was before. Additional ballast was not furnished, and as the space occupied by the steel ties was so much smaller than that occupied by the wooden ties, there was not sufficient ballast to half fill the track. Between November, 1904, and June, 1905, the road at this point was single track, and carried the entire tonnage of the B. & L. E. R. R. On this section southbound trains are assisted by pushers, and during a portion of the time pushers with 180,000 lbs. on the drivers were used. Since June, 1905, southbound traffic only has been handled over these ties. The supervisor reports that after the steel ties were put in on this curve he had much less trouble in keeping the track in line than he did before, notwithstanding it was hardly half filled with ballast. Considering that from November to June the pushers were backing up around this curve, that this track held its line is very significant.

Since then we have received 105,000 of these ties, about 70,000 of which have been placed in the track, to give them a thorough test under conditions existing on the B. & L. E.

Substantially all the freight of this road is handled on that part of the line between Conneaut Harbor and North Bessemer, which is 146 miles long. The freight tonnage is about 10,000,000 net tons per annum, with an average haul of about 120 miles; the line crosses eight watersheds, and as southbound 30-ft. grades and over are operated with pushers, it has seven pusher districts, covering about 33 per cent. of the road. The curves generally are from three to four degrees, though there are a number running from six to eight degrees. On the north 15 miles of this line engines with 225,000 lbs. on the drivers and on the south end engines with 160,000 and 180,000 lbs. on the drivers are used in handling freight trains. About 8,000,000 tons of freight is ore and coal, loaded, so that the gross weight of the carload runs from 136,000 to 144,000 lbs., producing a load of 34,000 to 36,000 lbs. on the axle, and as 60 per cent. of this line is still single track, the service is very severe.

This year we have made two changes in line, one-half a mile long and the other 3½ miles long. In this work and on all second track work we have used steel ties. On a portion of this work the track was laid with steel ties across a creek bottom and blocked up, and afterward raised to grade by running on it the necessary filling in 80,000 to 100,000 lbs. capacity cars, loaded to their full capacity, which was unloaded and used in raising the track. We are using these ties in new work under all conditions where wooden ties have been used, and find that, taking everything into consideration, it can be done with the same facility and convenience as with wooden ties. In maintenance work either steel or wooden ties, whichever happens to be on hand, are distributed. Steel ties are used in renewing, whether there be one, two or more ties in a place to be renewed; that is, they are used in the main tracks under all conditions where wooden ties have been used.

We have observed where steel ties are used that there is less wear and a more uniform wear of rails. This is accounted for by the better fastening, securing a better connection between rail and tie, preventing the rail from rolling and producing a lateral rigidity in the track structure independent of the ballast.

The steel tie maintains its section, and the bed under the tie does not have to be disturbed on account of tie becoming soft, nor on account of the effective thickness of the tie becoming less due to rail or tie plate bedding into the tie. The steel tie up to failure retains the same dimensions and efficiency, reducing the work required for surfacing and lining, and it is possible throughout the life of the tie to maintain track of the same excellence as with all new ties. Up to the present time we have only had one broken rail on steel ties, and the report attributes this break to a flaw in the rail.

We have not used steel ties long enough to determine their life under our conditions, but an examination of a broken tie after six years' service does not indicate that rusting under ordinary conditions should cause any anxiety.

We have stretches of track laid with all-steel ties up to 4.4 miles in length, and find that after the track is filled with ballast there is a very appreciable reduction of noise in general and at the joints below what can be obtained with wooden tie track.

*Extract from a paper by H. T. Porter, Chief Engineer, Bessemer & Lake Erie, read at the September meeting of the Railway Club of Pittsburg.

Early Government Ownership in Pennsylvania.

The following extract is from an article in the *Wall Street Journal* describing an early trial of government ownership of railroads in the state of Pennsylvania. The information is taken from the "History of the Pennsylvania Railroad" by William B. Wilson. It will be recalled that a five-page illustrated article entitled "The First Railroad Owned and Operated by a Government," describing in detail the history of the Philadelphia & Columbia and the Alleghany Portage railroads, which were owned by the state and are now part of the Pennsylvania, was published in the *Railroad Gazette* of August 24, 1906. The quotation follows:

The following were some of the evils developed in this trial of government ownership. Millions were squandered in construction; the public were punished or rewarded as they denounced, or sided with, those in position; employees were plundered by so-called assessments; the ballot-box was polluted for the purpose of perpetuating power; all the avenues of government were completely corrupted; the state credit collapsed, and the public improvements of Pennsylvania became public scandal. The officials in charge frequently clashed while lobbying in the legislatures for appropriations for their different departments, and these appropriations, when received, were applied in a way to advance the fortunes of the political faction to which the officials belong. Ten per cent. of the pay of employees was deducted from the pay-rolls by the paymasters and put in bags labeled "Political Assessments." Passengers and freight were carried in cars of individual transporters who were charged a wheel toll for motive power, and a rate per mile on passengers and a rate per ton mile on freight. These individual transporters were obliged to dance when the politicians in charge of the road piped. Free passes abounded. All the public officers demanded free transportation, not only for themselves, but for their political hangers-on. This became a potent factor in political corruption. The state debt grew until bankruptcy stared the people in the face. It was conditions such as these that finally drove the people to elect a legislature that would sell the public works. The price obtained was more than their value, but only one-quarter of the amount of public money expended on them. The system, when sold, was in such a condition that it had to be rebuilt at once.

Such were the results of the first extensive experiment in government ownership and operation of railroads in this country. It is a record that does not constitute a potent argument in favor of Mr. Bryan's scheme. Compare that record with the history of corporation control of railroads, and the latter, with all its evils, is infinitely to be preferred. It is fearful to contemplate what would be the political consequences of government ownership of the great railroads of this country even under a better system of civil service than that which now prevails. Even admitting that government ownership might now be conducted on a much higher plan of efficiency and honesty than that which prevailed in Pennsylvania over half a century ago, is it reasonable to believe that government operation of railroads would be as efficient and economical as that which now prevails?

The ideal solution of the railroad problem is that towards which we are now rapidly approaching. It is ownership and operation by private capital subject to rigid government supervision. This secures the benefits of private enterprise and control and at the same time the advantages of public regulation in the interest of equitable rates.

GENERAL NEWS SECTION

NOTES.

The Philadelphia & Reading has increased the wages of enginemen, conductors, brakemen and other employees on all divisions from 5 to 10 per cent. The order took effect October 1.

A serious car shortage exists both at Pittsburg and at Chicago. The vice-president of the New York Central Lines West in charge of traffic estimates the daily shortage at Chicago at 5,000 cars.

Beginning November 8 the Atlantic Coast Line is to operate a special car once a week between Chicago and Jacksonville, Fla., to handle butter and cheese only. The route of the refrigerator car will be over the Illinois Central, Nashville, Chattanooga & St. Louis, Central of Georgia, and the Atlantic Coast Line.

J. J. Byrne, assistant passenger traffic manager of the Atchison, in an address before the General Passenger Agents' Association at Atlantic City, said that during the past year the railroads of the United States earned $500,000,000. He had found that 10 per cent. of the travel was for health, 40 per cent. for business and 50 per cent. for pleasure.

The Southern Fruit Despatch Co. has been formed by the Southern Pacific, the Texas & Pacific and the Missouri, Kansas & Texas. The line will carry fruit from southern California to Kansas City, St. Louis and Chicago. The first train was to Los Angeles on October 15, and the trains are to have precedence over all other trains. It is intended that the M., K. & T. should get the train from Fort Worth to Kansas City at an average speed of 25 miles an hour.

The Cattle Raisers' Association of Texas has filed a complaint with the Interstate Commerce Commission to the effect that the recent cancellation of joint rates on live stock by three roads has resulted in discrimination, an advance having been made from $15 to $25 per car. James B. Mason complained that the Chicago, Rock Island & Pacific had charged him for the shipment of 24,000 lbs. of freight, although only 19,230 lbs. could be put into the cars in which the shipment was made.

Progress of the Quebec Bridge.

Satisfactory progress has been made during the summer months on the erection of the cantilever bridge over the St. Lawrence river at Quebec. This bridge, which is the longest cantilever in the world, has a clear span over the channel of 1,800 ft. On the south side of the river the steel work erected up to September 1 extended from the shore abutment to about 200 ft. beyond the main pier, a total distance of about 900 ft. The quantity of metal erected up to that date amounted to 11,300 tons. In addition to this, there is in storage at the works of the Phoenix Bridge Company, Phoenixville, Pa., and at the bridge site, 20,700 tons of manufactured material. On the north shore wharves are being built to receive material for the false work and traveler, which is being used at present on the south side and which will be transferred to the north side after the south cantilever arm is erected. Preparations are being made to commence work on the foundations for the false work on the north side. These foundations will be sunk by caissons. Work will be begun on the erection of the north anchor arm next spring and by May, 1907, it is expected that the manufacture of all the metal at the bridge works will be completed.

Opening of Purdue University.

Purdue University opened on September 12th with 1,588 students enrolled at the end of the second week. Of this number 1,379, or 86 per cent., were registered in the schools of engineering. New appointments to the instructional staff of the engineering departments for the present year have been announced as follows: W. K. Hatt, Ph.D., formerly Professor of Applied Mechanics, to be Professor of Civil Engineering, in charge of the department; Mr. Paul B. Breneman, B.S. 1894, C.E. 1897, State College of Pennsylvania, formerly engineer and superintendent mining construction and operation, to be instructor in Civil Engineering; Mr. Arthur W. Cole, B.S. Worcester Polytechnic Institute, 1902, formerly of the University of Maine, to be instructor in Thermodynamics; Mr. L. W. Wallace, B.S. Texas A. and M. College, 1903, late with the motive power department of the Santa Fe Railroad, to be instructor in Car and Locomotive Design; Mr. W. T. Small, B.S. Purdue, 1903, formerly with the Cooper-Hewitt Electric Company, to be instructor in the electrical laboratory; Mr. C. E. Schutt, B.S. Purdue, 1905, formerly with the New York Telephone Company; Mr. George W. Lamke, B.S. University of Michigan, 1906, and Mr. W. A. Rush, B.S. Purdue, 1906, to be assistants in the electrical laboratory; Mr. R. D. Kneale, B.S. Purdue, 1906, and Mr. M. L. Allen, B.S. University of Wisconsin, 1906, to be assistants in the civil engineering department.

The facilities of the engineering department have been increased by the completion of a building containing three floors, each 75 x 130 ft., for the Department of Civil Engineering, and by an addition to the Electrical Laboratory 68 x 90 ft., to give room for additional equipment. This room is to be served by a traveling crane which may be utilized in transferring heavy equipment from the laboratory to a new lecture room which adjoins. There have been added to the Materials Testing Laboratory and to the Steam Engine Laboratory a number of important machines, including a 100,000 pound Olsen testing machine, a Fairbanks-Morse 50 h.p. gas producer and gas engine, a 20 h.p. De Laval steam turbine with direct-connected centrifugal pump, a 16 and 10 x 14 air and 11 and 18 x 14 steam Ingersoll-Rand air compressor, a Foster superheater of the type supplied by the Power Specialty Company, a Gerry-Emmons gasolene engine, an Abner Doble water motor, and an Allis Chalmers 8 x 24-in. Corliss engine direct-connected with a centrifugal pump of 4,000 gallons capacity.

New York Central Sugar Rebate Case.

On October 16 at the trial in the United States Circuit Court at New York City of the New York Central for granting certain rebates, the following letters were admitted as evidence. The first is from the head of the traffic department of the American Sugar Refining Company:

New York, April 11, 1904

Nathan Guilford, Traffic Manager, N. Y. C. & H. R. R. Co., New York City:
(Personal and Confidential.)

Dear Sir:—A very serious state of affairs seems to threaten us in regard to shipments of sugar for W. H. Edgar & Son. Mr. Edgar's son called on me last week with a proposition to the effect that they would like this season to have their shipments of sugar made from New York by canal to Buffalo, we prepaying charges up to that point only. They state they have an arrangement with the Detroit & Buffalo line to take the sugars at Buffalo for distribution to Detroit and Edgar's other points in Michigan.

I wrote Mr. James Edgar on April 6 in regard to this matter as per copy of my letter attached, and I beg to call attention to his reply on April 8. They figure that they can land sugars in Detroit via canal to Buffalo and via D. & B. line for say, 13 cents per hundredweight, which weight is divided 7 cents to Buffalo, 1 cent for handling at that point, and 5 cents for hundredweight for the D. & B. line haul to Detroit.

I think that if we could arrange to give him a net rate of all rail of 18 cents per hundredweight to Detroit and the same relative basis to other Michigan points, that we could make an arrangement with him whereby these shipments would be confined strictly to the New York Central and West Shore fast freight lines throughout the entire year. If some arrangement of this kind cannot be made it is quite certain that Edgar's business will be put on the canal and rates arranged on it by himself beyond Buffalo. If such a course is pursued it will simply mean the disintegration of the present understanding for the division of the sugar traffic, as if a large shipper like Edgar is permitted to make his own rates it will only be a very short time before every large wholesale grocer in the United States will want the same privilege.

As you can easily see, this is a matter of the most vital importance, not only to us, but to the railroad companies, and I sincerely trust that you will see your way clear to giving us authority to make such an arrangement with Edgar as will confine his business to the all-rail route.

You understand that before the time that sugar was put into the fifth class the rate to Detroit by the standard lines was 20 cents per hundredweight, as against the differential line rates of 18 cents, and if this latter figure can again be secured for them, I am quite hopeful that we can make a satisfactory arrangement with Edgar which will do away with his demands for canal and lake shipments.

Yours very truly,
LOWELL M. PALMER (in person).

N. Y. C. & H. R. R. Co.
New York, April 26, 1904.
F. L. Pomeroy, Ass't Traffic Mgr.
(Private and Confidential.)

Lowell M. Palmer, Esq.

Dear Sir:—Referring to your letter of April 11, and my conversation over the 'phone yesterday, the 25th instant, with your Mr. Riley, which, I understand, was repeated to you and verified, all in regards to such shipments for W. H. Edgar & Son.

This is to advise that, taking effect immediately, we will undertake to handle Edgar's shipments for Detroit, and such shipments as are to be reforwarded from there to points on the Michigan Central Railroad at the rate of 18 (eighteen) cents per one hundred pounds, New York to Detroit, all rail shipments to be billed at tariff rates and refund made by voucher.

As advised over the 'phone, I think it would be well to confine arrangement to Edgar's traffic, as outlined above, leaving his traffic that is going to points on the Grand Trunk, Pere Marquette and G. R. & I. roads to move via such lines as he may elect, with the understanding that where he can favor either the West Shore or this company, as far as the haulage is concerned, he will undertake to do so. Please advise if satisfactory and understood.

Yours truly,
(Signed) F. L. POMEROY.

H. T. Leeming, who was formerly a clerk in the sugar company, testified that he had made out claims for the rebates due

under the arrangement agreed to in the above letters. He sent these claims, which were at the rate of 5 cents for each 100 lbs., to the railroad company, which sent drafts in payment, and these he deposited to the credit of Mr. Palmer in a New York bank. The railroad company and Mr. Pomeroy were each found guilty on six counts; the maximum penalty is $20,000 for each offense. The case will be appealed.

Boston Terminal on Labor Day.

Perhaps the most envied railroad operating officers that could be named would be those who operate the Boston Terminal Company, with its eight main tracks and other magnificent facilities. On Labor Day this year 50 extra trains were run to or from the station and yet there was only one short delay, as shown in the statement below, furnished by an officer:

Memorandum of Trains and Cars Handled at Boston South Station, on Labor Day, Monday, Sept. 3, 1906.

	Trains					No. of cars.		
	Regular		Extra					
	Out.	In.	Out.	In.	Total.	Out.	In.	Total.
Boston & Albany	113	112	9	4	238	544	475	1,019
Plymouth Division	113	114	9	11	247	538	548	1,086
Providence Division	141	140	7	10	298	531	490	1,021
Midland Division	44	44	..	..	88	117	123	240
Totals	411	410	25	25	871	1,730	1,636	3,366
Engines	871.		Total cars and engines			4,237		

Fifty extra trains were run. On account of holiday, seven regular trains were omitted. The only delay in the terminal yard was of one train, six minutes, by changing engines when wrong cars were backed in for an outgoing train. The cars and engines represented in the statement would, if coupled together, reach approximately 53 miles.

Changes in the University of Colorado.

At a recent meeting of the Regents of the University of Colorado the name of the engineering department was changed from the School of Applied Science to the College of Engineering of the University of Colorado. Professor M. S. Ketchum, formerly Dean of the School of Applied Science, is Dean of the College of Engineering.

New Passenger Steamer for Lake Erie Service.

Orders were recently given for eight new steamers, which is one of the largest orders for merchant ships, to the American Shipbuilding Company by the Lackawanna Steamship Company. The steamers are to be delivered in time for the opening of the new season of navigation in 1908. The contract is valued at about $3,000,000.

New Hudson River Steamer for the Albany Day Line.

Negotiations are under way for the construction of a new steamer similar to the "Hendrik Hudson," recently placed in commission by the Albany Day Line. The steamer is to be built at the Marvel Ship Yard at Fishkill Landing, N. Y. Although designed to be a sister ship of the "Hendrik Hudson," the new steamer will present some pleasing contrasts to the other steamer. It is expected that the "Fulton" will be put in commission in 1909, in time to participate in the joint Hudson-Fulton celebration planned for that year.

Dissolution of Ohio Bridge Companies.

According to press despatches of October 9, five bridge companies in Ohio have surrendered their charters; the Champion Bridge Company of Wilmington, the King Bridge Company of Cleveland, and the Canton, Bellefontaine and Massillon companies. The four last named companies, with the Mount Vernon Bridge Company, were indicted about six months ago for violation of the Ohio anti trust law, and five agents were also indicted, one connected with each company. In the Common Pleas Court all were found guilty and fined $500 each. The Mount Vernon Bridge Company is not named among those which have surrendered their charters and, it is supposed, will continue the contest in the courts. The court appointed trustees to wind up the affairs of the five companies which have surrendered.

New Engineering Building of the University of Pennsylvania.

On Friday, October 19th, the new engineering building of the University of Pennsylvania is to be dedicated. The principal addresses will be given by F. W. Taylor, President of the American Society of Mechanical Engineers, and Dr. A. C. Humphreys, President of Stevens Institute of Technology. The building has a frontage of 300 ft. and is 210 ft. deep at one side and 160 ft. at the other. In the basement are laboratories for geodetic and hydraulic work and for testing construction material. On the first floor are offices, a cement laboratory and part of the hydraulic laboratory, which extends into the basement. In the center of this floor is a space 200 ft. x 50 ft. for wood and iron working shops, a foundry and a forge shop. The mechanical laboratory and part of the electrical laboratory are also on this floor. The library, reading room and lecture rooms are on the second floor. On the third floor is a large assembly room for the engineering societies and recitation rooms. The engineering department of the university was started in 1874. There are now 40 teachers and nearly 600 students in this department.

TRADE CATALOGUES.

Coaling Cranes.—The Brown Hoisting Machinery Co., Cleveland, Ohio, is distributing a pamphlet illustrated from photographs of "Brownhoist" locomotive-coaling cranes at work coaling locomotives, filling coaling pockets and unloading gondola cars. These machines are pivoted on four-wheel trucks or eight-wheel flat cars in the same manner as a wrecking crane, and a clam shell bucket is suspended from the end of the boom.

Railroad Machinery.—The Quincy, Manchester, Sargent Co. sends half a dozen of their recent catalogues, describing metal sawing machines, portable tools for repair shops, riveting machinery and car and engine equipment. The pamphlets are bound in an adjustable binder which is noticeable for its convenience and attractive appearance.

Pneumatic Drills.—Bulletin No. 2,007 of the Ingersoll-Rand Co. is devoted to "Imperial" piston drills. The motor used in these tools has three cylinders revolving around the rigid main bearing, which serves as a valve seat for the rotating valve carried by the cylinders. A special feature of the drill is that the main pin forms a Corliss valve.

Direct Current Motors.—Bulletin No. 219 of the Sprague Electric Co. illustrates and gives full descriptions of the round type direct current motors for driving machine tools, pumps and other machinery. A special pamphlet is also being distributed by this company describing motors for driving, ventilating fans and blowers.

Electric Motors for Machine Tool Drive.—The Northern Electrical Manufacturing Co., Madison, Wis., is distributing bulletin No. 53, which gives a history and full description of their single voltage variable speed motors for driving machine tools as well as of the controlling apparatus for different motor driven tools.

"Through Frisco's Furnace."—Under this title, the Joseph Dixon Crucible Co., Jersey City, N. J., has published some unusually fine photographs taken shortly after the San Francisco fire. The buildings in the pictures are some of those in which the structural work was painted with Dixon's graphite paint.

Steel Sheet Piling.—The United States Steel Piling Co., Chicago, is distributing an illustrated pamphlet showing several structures in the foundations of which United States sheet piling is being used.

Manufacturing and Business.

H. G. Jansen, manager of the car department of M. H. Treadwell & Co., Lebanon, Pa., has resigned.

The General Storage Battery Co. is starting work at Boonton, N. J., on a new five-story building, and additional generating units are being installed.

The Goldschmidt Thermit Company has moved its plant from 179 Christopher street, New York City, to their new building at the corner of Cornelison and Bishop streets, Jersey City, N. J.

Rudolph P. Miller, M. Am. Soc. C. E., formerly Chief Engineer of the Bureau of Buildings, New York City, has opened an office as Consulting Engineer at 527 Fifth avenue, New York City.

The Kennicott Water Softener Co., Chicago, has received through its London office an order from the Eckstein Group of the Rand Mines, Ltd., Johannesburg, South Africa, for seven water softeners.

The B. F. Sturtevant Co., Boston, have recently installed heating apparatus in the New York Central shops at West Albany, N. Y., and in the 12-stall roundhouse of the Southern at Greenville, N. C.

C. R. Naylor, assistant chief clerk to the Superintendent of Motive Power of the Atchison, Topeka & Santa Fe, will go to the western sales office at Chicago of the T. H. Symington Co., makers of journal boxes at Corning, N. Y., on November 1st.

E. H. Lynde, who has for some years been in charge of the Bessemer rail department of the Lackawanna Steel Co., has gone to Robert W. Hunt & Co., Chicago, to take charge of the departments in that company formerly managed by Albert W. Fiero, who died recently.

The Foundation Company, New York, has begun work on the piers, abutments and pedestals for a railroad bridge and a highway bridge across the canal which carries water to the plant of the Pittsburg Reduction Co. at Massena, N. Y. The piers of the railroad bridge will be 50 ft. high, resting on bed rock about 30 ft.

below water level. The work on the foundations for both bridges will be done with pneumatic caissons.

The Universal Portland Cement Co. has been incorporated, as a subsidiary of the United States Steel Corporation, and has taken over the property and business of the cement department of the Illinois Steel Co. The new company will continue the manufacture of Universal Portland cement and new plants are being built, to be in operation by the summer of 1907, which will increase the output from 6,500 barrels per day to over 17,000 barrels. E. M. Hager, who for the last six years has been manager of the cement department of the Illinois Steel Co., is president of the new company, with offices at The Rookery, Chicago, Ill.

The Dixon Car Wheel Co., Houston, Tex., recently acquired 20 acres of land on Washington street at that place and has begun work on a new car wheel foundry on part of the property. Contracts have been let also for additional machinery and supplies needed in the new building. The plant will turn out 400 wheels a day. The present foundry, which has a capacity of 210 wheels per day, will be operated until the new foundry is in operation early next year. Ultimately the entire new ground will be covered with machine and pattern shops. A. W. Slocum, formerly superintendent of the National Car Wheel Co., Pittsburg, Pa., is superintendent of the new foundry.

P. E. Kobbe, Director and Assistant Secretary of the Westinghouse Electric & Mfg. Company, died at his summer home at Stockbridge, Mass., on Friday, September 21st, aged 64 years. Mr. Kobbe was born in New York in 1842 and received his education in Germany. In 1883 he was elected treasurer of the United States Electric Lighting Company, which position he held until 1890, when the United States Electric Lighting Company was absorbed by the Westinghouse Electric & Mfg. Company, at which time Mr. Kobbe was made treasurer of the latter company. In 1896 Mr. Kobbe was made vice-president in addition to his duties as treasurer, and in 1902 he became a director of the company. It was in the year 1900, when Mr. Kobbe was on his way to Europe to undertake important work in connection with Mr. Westinghouse's foreign interests that he was stricken by an attack of paralysis, from which it is believed he never fully recovered. Continued ill health recently compelled him to be relieved of his duties as treasurer and vice-president, but up to the time of his death he remained on the board of directors and held the office of assistant secretary. He was the fortunate possessor of an evenly balanced mind which enabled him to consider the most trying and perplexing problems in a manner which could only bring confidence and inspiration to those who worked with him.

Iron and Steel.

The Canadian Pacific has ordered 19,000 tons of steel for bridges from a Canadian firm.

The American Bridge Company has been given orders for 1,000 tons of fabricated steel for ore docks for the Chicago & North-Western, and 2,000 tons for the construction of cement plants in Pennsylvania.

The order for 66,000 tons of rails for the Baltimore & Ohio was divided as follows: Maryland Steel Co. 11,500 tons, Cambria Steel Co. 17,400 tons, and Carnegie Steel Co. 37,100 tons, for delivery during the first half of 1907. The contracts are worth about $1,848,000. The National Railroad of Mexico has let a contract for 5,000 tons of rails, and the Mexican International has placed an additional order for 5,000 tons for 1907 delivery with eastern mills. A number of small contracts for structural shapes have been let—the largest order for railroad work being 1,200 tons for the Pennsylvania, while the New York Central and New York, New Haven & Hartford bridge work is still pending.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

The Engineers' Club of Philadelphia.

At the meeting of this club October 20 a paper on "Further Notice on the Summation of Stresses in Certain Structures," by John C. Trautwine, Jr., illustrated by lantern slides, will be presented.

Franklin Institute.

At the stated meeting of the Institute Oct. 17 the programme included an address on "Legislative Engineering," with illustrations, by J. C. Trautwine, Jr.; also one on "Recent Progress in Metallurgy," by Prof. A. E. Outerbridge, and a demonstration of the Decker primary battery by Prof. Carl Herring.

Car Foremen's Association of Chicago.

At the annual meeting, held Monday, October 8, the following officers were elected: President, O. M. Stimson (M. C. B., Swift & Co.); First Vice-President, T. H. Goodnow (M. C. B., L. S. & M. S.); Second Vice-President, P. H. Peck (M. M., C. & W. I.); Treasurer, W. E. Sharp (Supt. Armour Car Lines); Secretary, Aaron Kline (326 N. 50th Court).

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Albany & Susquehanna.—George B. Butler has been elected President of the Albany & Susquehanna. The following directors have been elected: John S. Kennedy, John Harsen Rhoades, Adrian H. Joline, George B. Butler, William Stewart Todd, Isaac N. Phelps Stokes, Howard O. Sturges, George L. Shearn, William A. Stewart, John H. McClement, Arthur W. Butler and Henry E. Howland, of New York, and Charles C. Cooley, of Hartford, Conn. They succeed Robert M. Olyphant, David Wilcox, Robert Olyphant, Charles A. Walker, R. Suydam Grant, Charles A. Peabody, of New York; William L. M. Phelps, Robert C. Pruyn, James H. Manning and Abel I. Culver, of Albany; George I. Wilber, of Oneonta; Harrison L. Beatty, of Bainbridge, and DeWitt C. Dow, of Cobleskill.

Baltimore & Ohio.—J. R. Foard, President of the Joseph R. Foard Lighterage Co., of Baltimore, has been elected a Director of the Baltimore & Ohio, succeeding John B. Thayer, who resigned recently.

Boston & Maine.—Moses Williams, President of the Fitchburg Railroad, has been elected a Director of the Boston & Maine, succeeding Henry R. Reed, deceased.

Chicago & Alton.—B. F. Yoacum has been elected Chairman of the Executive Committee, which consists of E. H. Harriman, James Stillman, W. H. Moore, B. F. Yoacum and B. G. Reid. Robert Mather, who is a member of the Finance Committee of the Rock Island Company, has been appointed General Counsel of the Chicago & Alton. George F. Boggs has been appointed Secretary, succeeding Alexander Millar. H. E. R. Wood, Assistant Treasurer, has been appointed Treasurer. C. W. Hillard has been appointed Comptroller, succeeding William Mahl.

Chicago, Peoria & St. Louis.—Chas. E. Kimball, President, has resigned. Mr. Kimball remains on the Board of Directors.

Cincinnati, Hamilton & Dayton.—R. R. Rhodes, Cleveland; Samuel Spencer, President of the Southern; Henry F. Shoemaker, of New York, and W. L. Dechant, Middletown, Ohio, have been elected Directors.

Delaware & Hudson.—See Albany & Susquehanna.

Illinois Central.—James D. Cutting, New York, has been elected a Director, succeeding W. M. Grinnell, deceased.

Lake Erie & Pittsburg.—W. H. Newman, President of the New York Central & Hudson River; D. W. Pardee, Secretary of the New York Central; E. A. Handy, General Manager of the Lake Shore & Michigan Southern, and Samuel Rockwell, Chief Engineer of the Lake Shore & Michigan Southern, have been elected also to the same offices on the Lake Erie & Pittsburg.

New York Central & Hudson River.—See Lake Erie & Pittsburg.

Oregon Short Line.—L. H. Connell and H. B. Taylor, both of New York, have been elected Directors, succeeding Otto H. Kahn and G. M. Lane.

Pennsylvania.—R. H. Groff, Assistant Secretary at New York, has been transferred to Philadelphia with the same title. J. W. Marshall, Assistant Treasurer, succeeds Mr. Groff.

Seaboard Air Line.—W. J. Calvert has been appointed Assistant Treasurer, with office at Portsmouth, Va., succeeding R. L. Nutt, promoted.

Temiskaming & Northern Ontario.—C. B. Smith, Chairman of the Board, has resigned to go into other business.

Union Pacific.—A. J. Earling, R. W. Goelet and David Wilcox have been elected Directors, succeeding Otto H. Kahn, T. T. Eckert and Jacob H. Schiff.

Wabash.—J. J. Slocum has been elected a Director, succeeding Russell Sage, deceased.

Operating Officers.

Central Vermont.—E. D. Nash, Assistant Superintendent at New London, Conn., has been appointed to the new office of Superintendent of the Southern division, with office at New London, and his former office has been abolished.

Chicago Great Western.—The office of Assistant General Manager, formerly held by Tracy Lyon, who resigned recently, has been abolished.

Jamestown, Chautauqua & Lake Erie.—C. M. Harrison, Superintendent, has resigned to go to another company.

Lake Shore & Michigan Southern.—J. J. Bernet, who was recently appointed General Superintendent, was born in New York State in 1868. He left school when 15 years old and worked for five years as a blacksmith. He began railroad work in 1889 as a telegraph operator on the Lake Shore and he has been with that company ever since. He was made train despatcher in 1895 and trainmaster in 1901. Two years later he was appointed Assistant Superintendent of the Eastern division. In February, 1905, he was promoted to be Superintendent of the same division and later in the year was made Assistant General Superintendent. He was promoted to his present position on Oct. 1, 1906.

J. J. Bernet.

New York Central & Hudson River.—D. B. McCoy, who was recently appointed Assistant to the General Manager, began railroad work when 15 years old as telegraph operator on the Pittsburg division of the Pennsylvania. The next year, 1862, he was a telegraph operator in the United States Army. In 1863 he was transferred to the Pittsburg, Ft. Wayne & Chicago. He was later appointed train despatcher and then Division Superintendent of this road after it had been leased to the Pennsylvania. In 1881 he went to the Chicago & North-Western as Superintendent of the Wisconsin and Milwaukee divisions. Three years later he was made Superintendent of the Buffalo division of the West Shore, and in 1890 was appointed Superintendent of the Hudson and Putnam divisions of the New York Central as well as Superintendent of the Hudson River Bridge Company. He remained in these offices until his recent promotion.

D. B. McCoy.

James H. Hustis, who has been appointed Superintendent of the Hudson division, was born in New York in 1864. After a public school education, he began railroad work in 1878, and has been on the New York Central & Hudson River ever since, starting as an office boy in the office of the Superintendent of the road; he was made Chief Clerk to the General Superintendent and then Trainmaster of the Harlem division. He was next appointed Assistant Superintendent of that division and then Superintendent. He was transferred to the River division, and in 1902 was made Superintendent of the Rome, Watertown & Ogdensburg, where he remained until his recent appointment.

J. H. Hustis.

New York, Chicago & St. Louis.—W. L. Blair, Superintendent at Buffalo, N. Y., has been appointed to the new office of Superintendent of Transportation, with office at Cleveland, Ohio. W. F. Watterson, trainmaster at Conneaut, Ohio, succeeds Mr. Blair.

New Orleans & Northwestern.—A. E. Wyatt, Superintendent, has resigned to go into other business.

Vera Cruz & Pacific.—John D. Melville, who was recently appointed Superintendent, was born in Canada in 1858 and educated at public and military schools. He began railroad work in 1880 as a brakeman on the Grand Trunk. After serving on several south and southwest roads, he went to the National of Mexico. He was made Superintendent of Construction of the Coahuila & Zacatecas, and after building the road remained a year as Superintendent. He was then appointed Superintendent of Construction of the Coahuila & Pacific, and after the completion of that road was made General Superintendent. He resigned for a year and a half on account of ill health, and started business as a contractor for railroad construction. He re entered railroad service as Superintendent of the Vera Cruz & Pacific.

Traffic Officers.

Baltimore & Ohio.—J. P. Dugan, traveling baggage agent, has been appointed General Baggage Agent, with office at Baltimore, Md., succeeding B. E. Peddicord, deceased.

Canadian Pacific.—John Halstead has been appointed Assistant General Freight Agent at Calgary, Alberta, succeeding H. H. Abbott, resigned.

New York Central & Hudson River.—Herbert D. Carter, who was recently appointed General Freight Agent, was born in New York state in 1860 and began railroad work when 15 years old as a telegraph operator on the Rome, Watertown & Ogdensburg. The next year he was made clerk in the General Freight office of the same road, being appointed chief clerk in 1881. Seven years later he was transferred to the Williamsport, Pa., freight office of the Northern Central and the Philadelphia & Erie, now part of the Pennsylvania. After serving for two years in the general freight office of the Philadelphia & Reading, he was made Assistant General Freight Agent of the St. Lawrence & Adirondack. When this road was consolidated with the New York Central, Mr. Carter was made division freight agent of the St. L. & A. division. In 1902, he was appointed Assistant General Freight Agent of the New York Central and of the West Shore. In 1904 he was promoted to be General Freight Agent of the West Shore, where he has remained until his recent appointment.

H. D. Carter.

The jurisdiction of division freight agents has been rearranged as follows:

Western District.—All stations on N. Y. C. & H. R. and West Shore R. R., Despatch, Pittsford, Wheelers, N. Y., and west thereof, including R., W. & O. division west of Webster, N. Y., also Charlotte branch (N. Y. C.) and Rochester branch (R., W. & O.).

Middle District.—All stations on N. Y. C. & H. R. and West Shore east of Despatch, Pittsford and Wheelers, N. Y., to, but not including Utica and New York Mills, N. Y., also including Chenango branch West Shore. This does not include traffic moving from Geneva and Lyons to or via Pennsylvania district stations, or from Syracuse and Rome to or via Northern district stations. Such traffic will be under the jurisdiction of the Division Freight Agents of the Pennsylvania and Northern districts, respectively.

Mohawk District.—All stations on N. Y. C. & H. R. and West Shore, Utica and New York Mills, N. Y., and east thereof to and including Troy, Rensselaer and Ravena, N. Y., also including Troy and Troy branch (N. Y. C.) and Albany branch (West Shore). This does not include traffic moving from Utica to or via Northern or Adirondack district stations, or from

Herkimer to or via Adirondack district stations. Such traffic will be under the jurisdiction of the Division Freight Agents of the Northern and Adirondack districts, respectively.

Eastern District.—All stations on N. Y. C. & H. R., south of Rensselaer, also Chatham, N. Y., and south thereof, including Putnam division, and all stations on West Shore south of Ravena, including Wallkill Valley Railroad.

Northern District.—All stations on R., W. & O. division, Webster, N. Y., and east thereof to Sackets Harbor, Cape Vincent, Clayton, Ogdensburg, Massena Springs, Syracuse, Rome and Utica, including traffic from Syracuse, Rome and Utica to or via Northern district stations only; also Gouverneur & Oswegatchie (Edwards branch) and Carthage and Adirondack branch.

Pennsylvania District.—All stations on N. Y. C. & H. R. south of Lyons and Geneva, N. Y., also including traffic moving from Lyons and Geneva to or via Pennsylvania district stations.

Adirondack District.—All stations on N. Y. C. & H. R. and St. L. & A. north of Herkimer, N. Y., to Hinckley and Saranac Lake, N. Y., and Montreal, P. Q., including traffic moving from Utica and Herkimer, N. Y., to or via Adirondack district stations; also including Raquette Lake Railway.

San Pedro, Los Angeles & Salt Lake.—E. W. Gillett, General Freight and Passenger Agent, has resigned to go into other business.

Engineering and Rolling Stock Officers.

El Paso & Southwestern.—The office of the Superintendent of Motive Power has been removed from Douglas, Ariz., to El Paso, Tex.

Illinois Central.—M. H. Hovey has been appointed Signal Engineer, with office at Chicago, succeeding W. A. D. Short, resigned. Mr. Hovey began railroad service with the Chicago & North-Western in 1897. He was for two years General Foreman on the Houston & Texas Central, and for the past two years has been with the General Railway Signal Co. at Buffalo.

Pennsylvania.—J. W. Sanford, Master Mechanic at Meadows, N. J., has been retired on a pension.

Philadelphia & Reading.—G. S. Allen, Master Mechanic at Tamaqua, Pa., has been retired on a pension. C. M. Stuart, road foreman of engines at Tamaqua, succeeds Mr. Allen.

Seaboard Air Line.—W. D. Faucett, Assistant Engineer at Savannah, Ga., has been appointed First Assistant to the Chief Engineer, with office at Portsmouth, Va. E. C. Bagwell succeeds Mr. Faucett.

LOCOMOTIVE BUILDING.

The Great Northern has ordered 150 locomotives from the Baldwin Locomotive Works.

The Northern Pacific has ordered from the American Locomotive Co. 60 locomotives in addition to the recent order for 90 engines.

The Chicago, Rock Island & Pacific has ordered 30 consolidation (2-8-0) locomotives from the American Locomotive Co., and 20 switching engines from the Baldwin Locomotive Works.

The New York Central Lines have ordered 15 locomotives from the American Locomotive Co. in addition to the 200 locomotives reported in our issue of October 5th, and contracts are to be let for 200 more.

The Norfolk & Western is in the market for 15 Pacific (4-6-2) locomotives. These will be duplicates of the five Pacific type locomotives ordered from the American Locomotive Co. last year, the specifications for which were published in our issue of Aug. 18, 1905.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 50 locomotives from the American Locomotive Co. Thirty-two of these 50 locomotives will be compound mogul (2-6-0), exact duplicates of the locomotives reported in our issue of March 16 last. The balance of the order (18) have not yet been decided upon.

The Erie has ordered from the American Locomotive Co. for April, 1907, delivery, three Mallet compounds. The specifications are as follows:

General Dimensions.

Type of locomotive	Mallet (0-8-8-0)
Weight, total	410,000 lbs.
Weight, on drivers	410,000 lbs.
Cylinders	25 in. x 28 in. and 39 in. x 28 in.
Diameter of drivers	51 in.
Working steam pressure	215 lbs.
Total heating surface	6,108 sq. ft.
Tubes, number	468
Tubes, diameter	2¼ in.
Tubes, length	21 ft.
Firebox, length	128 in.
" width	114 "
Grate area	100 sq. ft.
Tank capacity	8,500 gals.
Coal capacity	16 tons

The Chihuahua & Pacific has ordered three simple consolidation locomotives from the Baldwin Locomotive Works. The specifications are as follows:

General Dimensions.

Type of locomotive	Consolidation
Weight, total	155,000 lbs.
Weight, on drivers	142,000 "
Diameter of drivers	50 in.
Cylinders	20 in. x 26 "
Boiler, type	Wagon top
" working steam pressure	200 lbs.
" number of tubes	320
Material of tubes	Charcoal iron
Diameter of tubes	2 in.
Length of tubes	13 ft. 4½ "
Firebox, length	112 "
" width	42 "
" material	Homogeneous steel
Grate area	32 sq. ft.
Heating surface, total	2,465 "
Tank capacity	6,000 gals.
Coal capacity	10 tons

Special Equipment.

Air brakes	Westinghouse American
Boiler lagging	Magnesia
Couplers	Standard Coupler Co.
Injector	Sellers
Piston rod packing	Jerome
Valve rod packing	Jerome
Safety valve	Coale
Sight-feed lubricators	Detroit

The Atchison, Topeka & Santa Fe has ordered 12 compound Santa Fe (2-10-2) locomotives from the Baldwin Locomotive Works. The specifications are as follows:

General Dimensions.

Type of locomotive	Santa Fe
Weight, total	287,240 lbs.
Weight, on drivers	234,580 lbs.
Diameter of drivers	57 in.
Cylinders	19 and 32 in. x 32
Boiler, type	Wagon top
" working steam pressure	225 lbs.
" number of tubes	391
" tubes, material	Tyler iron
" diameter of tubes	2¼ in.
" length of tubes	19 ft. 11 in.
Firebox length	108 in.
" width	78 in.
" material	Lukens acid steel
" grate area	58 sq. ft.
Heating surface, total	4,796 sq. ft.
Tank capacity	8,500 gals.
Coal capacity	13½ tons

Special Equipment.

Air brakes	Westinghouse
Axles	Cambria steel
Bell ringer	Golmar
Boiler lagging	Magnesia
Brake-beams	National-Hollow
Brake-shoes	Perfecto
Couplers	Tower and National
Headlights	Company's Standard
Injector	Ohio
Journal bearings	Hewitt Mfg. Co.
Piston rod packing	U. S. Metallic Packing Co.
Valve rod packing	U. S. Metallic Packing Co.
Safety valve	Crane
Sanding devices	Leach
Sight-feed lubricators	Chicago
Springs	Simplex Railway Appliance Co.
Steam gages	American Steam Gage & Valve Mfg. Co.
Tires, driving, truck, and tender wheels	Standard Steel Works.

CAR BUILDING.

The Boston & Maine has ordered 1,000 box cars from the Laconia Car Co.

The Chesapeake & Ohio is receiving bids on 2,000 hopper cars of 100,000 lbs. capacity.

The Pittsburg & Lake Erie has ordered 1,000 steel cars from the Standard Steel Car Co.

The Boston & Maine denies having ordered any passenger coaches and dining cars from the Pullman Co.

The Hudson Companies have ordered 10 steel cars for February delivery from the Pressed Steele Car Company.

The Delaware, Lackawanna & Western has ordered 500 40-ton gondolas and is building some automobile cars at its own shops.

The Gould Lines are reported to be preparing standard specifications for a large number of cars to be ordered in the near future.

The O. F. Jordan Co., Chicago, has ordered three flat cars of 60,000 lbs. capacity from the Hicks Locomotive & Car Works. These cars will weigh 26,000 lbs., and measure 36 ft. long, 6 ft. 6 in. wide and 4 ft. 2 in. high, over all.

The Texas & Pacific is building six passenger coaches at its Marshall, Tex., shops. These cars will weigh 98,000 lbs. and will measure 76 ft. 9½ in. long, 10 ft. wide and 11 ft. high, over all. The special equipment includes:

Brake-beams	National Hollow
Brakes	Westinghouse
Couplers	National
Curtain fixtures	Curtain Supply Co.
Draft rigging	T. & P. Standard
Heating system	Gould
Light	Pintsch gas
Platforms	Standard Coupler Co.
Springs	Railway Steel Spring Co.
Vestibules	Pullman
Wheels	Marshall Car Wheel Co.

The Mexico, Oaxaca & Yucatan, 10 Wall street, New York City, will shortly be in the market for from 5,000 to 6,000 flat, box, stock and gondola cars.

The Mexican Southern has ordered three passenger coaches and two baggage cars for February delivery from the Mexican Car & Foundry Company, Mexico City.

The Mississippi Central is building at its Hattiesburg, Miss., shops 200 flat cars of 40 tons capacity. The cars will weigh 28,500 lbs., and will measure 40 ft. long and 8 ft. 6 in. wide, over all. Bodies and underframes will be of wood. The special equipment includes:

Air brakes	Westinghouse
Axles	Decatur Car Wheel Mfg. Co.
Brake-beams	Simplex
Brake-shoes	Streator
Brasses	More-Jones
Couplers	Janney
Draft rigging	Bradford
Dust guards	Harrison
Journal boxes	Symington
Paint	Charles R. Long, Jr., Co.
Springs	Phoenix Car Spring Co.
Sill pockets	Western Railway Equipment Co.
Trucks	Andrews Cast Steel
Wheels	Decatur Car Wheel Mfg. Co.

The Norfolk & Western is in the market for 25 passenger coaches, 10 baggage and express cars and four combination passenger and baggage cars. The passenger coaches will weigh 84,000 lbs., the baggage and express cars will weigh 86,000 lbs., and the combination passenger and baggage cars will weigh 85,600 lbs. The special equipment for all includes:

Brake-beams	Norfolk & Western
Brakes	Westinghouse
Brasses	Ajax plastic bronze
Couplers	Janney
Curtain fixtures	Edwards
Draft rigging	Gould
Light	Pintsch gas
Paint	Norfolk & Western specification
Platforms	Gould
Springs	Railway Steel Spring Co.
Trucks	Norfolk & Western
Vestibules	Pullman wide

RAILROAD STRUCTURES.

Chattanooga, Tenn.—Plans for a new passenger station to be built by the Chicago Station Company to be used by the railroads now entering the central station have been submitted for approval, and contracts for the work will be let shortly.

Fort Francis, Ont.—A steel drawbridge 510 ft. long, with a 75-ft. swing span, is to be built by the Duluth, Rainy Lake & Winnipeg over the Rainy river at this place.

Fort William, Ont.—A vote is to be taken on a by-law October 24 to authorize the construction of a steel and concrete roller lift bridge over the Kaninistikwin river. The bridge will be 400 ft. long and the estimated cost is $100,000.

Globe, Ariz.—The Gila Valley, Globe & Northern machine shops and roundhouse were recently destroyed by fire; the loss is about $100,000.

Kansas City, Mo.—The Chicago, Burlington & Quincy, it is said, has begun the construction of a bridge over the Missouri river here, to cost more than $1,000,000. This bridge is to replace the Hannibal bridge, built 50 years ago, which has been condemned by the government engineers.

Pense, Sask.—The Canadian Pacific will build a new station here.

Peoria, Ill.—Bids are wanted Nov. 6 for the construction of the superstructure work of a Scherzer rolling lift bridge across the Illinois river at this place. E. A. Furry is Commissioner of Public Works, Peoria.

Portland, Ore.—The Southern Pacific is replacing 32 wooden bridges on the Shasta route between Ashland, Ore., and this place with steel structures, also a number on the lines of the Oregon Railroad & Navigation Co. along the Columbia river and its tributaries were to be built during 1906. Steel has been ordered for the construction of the South Umpqua bridge near Myrtle Creek, Ore., which is being changed from a wooden trestle to a steel bridge with a through Pratt truss 180 ft. long. Each of the two approaches will be built with deck-plate girders 60 ft. long. The tracks will be 30 ft. above high water. The steel bridge over the Willamette river at Harrisburg, Ore., is nearly completed. It has cylinder piers and trestle approaches. There is one 150-ft. span, a 200-ft. steel span, a 240-ft. steel draw and another 200-ft. steel span.

Quebec City, Que.—The Canadian Northern is planning to build shops here.

Sacramento, Cal.—The new Western Pacific bridge across the American river at this place, on which work has been started, will be a pile pier structure at first, and concrete piers will be put in later. It will have plate girders.

Salamanca, N. Y.—The improvements to be made by the Erie Railroad at this place include additional tracks to cost $38,000; new ice house, $5,200; new freight house, $6,300, and new transfer platforms, $24,000. (Sept. 28, p. 81.)

Toronto, Ont.—The Canadian Pacific, it is said, will build a new station at Port Arthur; also concrete and steel additions to its engine houses at Revelstoke, and probably large machine shops at Lethbridge, Alb.

Winnipeg, Man.—Bids are wanted Nov. 20 by Alderman J. G. Latimer, Chairman, Committee on Works, for the steel superstructure of a highway bridge over the Red river, at Redwood avenue, Winnipeg. Col. H. N. Ruttan is City Engineer, Winnipeg.

Action is being taken by the Canadian Northern for the erection of hospitals for its employees at terminal points.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Amador.—Incorporated in California with $1,250,000 by J. L. Scotchler, C. B. Mills, J. C. Sullivan and J. B. Peck, of Berkeley; T. Hahns and L. A. Borger, of San Francisco, and T. N. Harvey, of Oakland. The company proposes to secure control of the Ione & Eastern, 12 miles long, in Amador County, and to extend the road northeast from Martell to Bartons, 21 miles.

Athens Terminal.—Incorporated in Georgia with $25,000 capital to build a two-mile spur track from Athens to the Seaboard Air Line. The incorporators include: W. W. Mackall, T. M. Cunningham, C. B. Epps, W. B. Davis and others.

Canadian Northern.—The St. James Bay line is to be opened for traffic from Toronto north to Parry Sound early this autumn, and will next year be extended north to Moose Mountains, 296 miles from Toronto, where the company owns extensive iron deposits. The company further propose to establish large smelting works at Toronto with steel rail mill, car and locomotive shops, so as to turn out their own equipment in the future. The money to be spent aggregates several million dollars for the proposed plants and shops.

This company, it is said, has finished surveys and succeeded in getting a four-tenths grade through the Yellow Head Pass, Rocky Mountains. The Grand Trunk Pacific is also making surveys from Edmonton to the summit of the Yellowhead Pass, which are not yet completed. Both roads were having a race to get into and through the Pass.

Action will soon be taken by this company to secure an independent line into the Union Station at Toronto. The Canadian Pacific and the Grand Trunk have separate tracks into the Union Station from the east, and the Canadian Northern wishes to be placed on the same basis as the other roads.

Canadian Pacific.—An officer writes that the Darlingford extension from Darlingford, on the La Riviere division, south to Kaleida, Man., 7.2 miles, was finished some time ago. On the Weyburn branch, extending from Weyburn on the northwestern extension of the Souris branch east to Stoughton, on the Arcola-Regina extension of the Souris branch, 36 miles, the contract has been let and work is under way by J. T. Hargrave, of Winnipeg, for grading 30 miles from Stoughton west. On the Lauder extension of the Souris branch, from Lauder west to Kandahar, 28.5 miles, track has been laid to Johnson's Creek, 20.1 miles, and the balance is to be finished this fall. On the Stonewall branch a contract has been given to J. D. McArthur, of Winnipeg, for grading north from Toulon for a distance of 20 miles. The company will do the tracklaying. On the Moose Jaw branch, which is under construction from Moose Jaw north to Tuxford, thence northwest to Rutland, 30.2 miles, and beyond that point for an additional 20 miles, track has been laid for 15.3 miles to Tuxford. P. R. Lamb, of Winnipeg, has the grading contract. Work on the West Selkirk branch of the Winnipeg Beach extension, now under construction from Winnipeg Beach north to Gimli, 9.28 miles, will be completed this fall.

The Guelph & Goderich, which has been under construction from Guelph west to Goderich, 80 miles, was to have been put in operation October 15.

Chandler & Okmulgee.—This company has filed a charter in Oklahoma, with $1,200,000 capital, and is reported to be a project of the Frisco to build a connecting east and west line from Chandler to Okmulgee, Ind. T., about 60 miles. The office of the company is to be at Chandler, and the incorporators include: Lee Patrick, of Strand; H. B. Gilstrap, G. B. Rittenhouse and M. D. Owen, of Chandler. Surveys have all been completed and construction work is to be started soon.

Chicago, Joliet & Kansas City.—At a recent meeting of the stockholders of this company it is said that the capital stock was increased from $1,000,000 to $12,000,000 and an issue of $10,000,000 bonds authorized. The previous action taken by the directors in relation to awarding construction contracts was also ratified, and

the line is to be built from Chicago to Kansas City. New capital had been subscribed for by eastern banking interests. The company is to be an entirely new and independent project, and the construction work on the Illinois division is to be commenced before January 1 and completed by December, 1908. Terminals have been secured in Chicago and Kansas City. (Aug. 24, p. 50.)

Chicago, Rock Island & Gulf.—This company has filed an amendment to its charter in Texas, providing for an extension from Irving north to Carrollton, 12 miles, in Dallas County. This extension is to connect the Fort Worth-Dallas, Rock Island line at Irving with the 'Frisco at Carrollton.

The directors at a recent meeting authorized the expenditure of a large sum during the coming year to lay heavy rails, for reballasting and putting in concrete work and new steel bridges on the Dallas line, also for laying new tracks in the Fort Worth yards.

Chicago, Rock Island & Pacific.—This company has bought land at Little Rock, Ark., on which it will build a new terminal to cost $1,000,000.

Cortland & Auburn.—At the first meeting in Binghamton, N. Y., of the stockholders of this company, B. L. Webb, of Binghamton, was elected President; W. A. Bundy, of Philadelphia, Vice-President, and E. L. Stone, of Homer, Secretary. The company is to build a line from Binghamton, N. Y., northeast via Cortland to Auburn, about 75 miles. Right of way for nearly the entire distance has been secured and construction work is to begin next spring.

Duluth, Rainy Lake & Winnipeg.—President W. H. Cook states that trains will be running over this road from Duluth to Winnipeg by the beginning of the next year. The road at present runs from Rainy Junction, Minn., where connection is made with the Duluth, Missabe & Northern north to Ashawa, 28 miles. Work has been under way for some time building an extension north to International Falls, where a bridge is to be built over the Rainy river to a connection with the Canadian Northern at Fort Francis. (See Construction Record.)

Edmonton (Alberta) Roads.—The city council has decided to build a municipal street railway. Address Mayor May.

Grand Trunk.—This company will shortly begin negotiations with the city of Montreal to consider the question of abolishing its grade crossings within the city limits.

Grand Trunk Pacific.—A recent report of the engineers making surveys for the National Transcontinental Commission, it is said, shows that a route has been found between Quebec and Winnipeg, 400 miles shorter than the earlier estimates, and will mean a saving to the Canadian government, who is building the line, of $15,000,000. Four hundred miles are already under construction, and the letting of the proposed contracts early in December for 500 miles additional will mean 900 miles, or half the mileage of the whole line from Winnipeg to Moncton. (Oct. 12, p. 98.)

Great Northern.—Surveyors have found a route through Hope Mountains, B. C., which had been looked upon as an insurmountable difficulty for the Vancouver, Victoria & Eastern, now under construction. Track laying has been completed to Molson and grading is completed as far as Keremeos. Additional grading contracts will shortly be let from Keremeos northwest to Princeton, about 40 miles. (Sept. 28, p. 84.)

Preliminary surveys are in progress by the engineering department of this road between Spokane and Newport, Wash., 70 miles, for the purpose of securing a more direct route and lighter grades on the line. The present route between Spokane and Newport is a roundabout one with steep grades. If a new route is decided upon it will probably be a year or more before actual work is begun.

Gulf & Sabine River.—Incorporated in Louisiana with $100,000 capital and office at Leesville to build a line from Leesville, La., on the Kansas City Southern southwest to Merryville, about 35 miles. The directors include: T. H. Fullerton, J. L. Reaves, G. W. Johnson, F. L. Feihen and C. S. Maillard.

Huntington Railroad (Electric).—This company has been authorized to build an electric line from Huntington, on the Long Island Railroad, southwest across Long Island to Amityville, about 15 miles. Work is to be started by April 1, 1907, and completed by October, 1908. The names of the directors are not given.

Marianna, Brinkley & Western.—Surveys have been completed and right of way secured for this proposed road from Marianna, Ark., northwest to Brinkley, 30 miles. Contracts are to be let early next year for the work. G. W. L. Brown, of Marianna, is General Manager. (June 29, p. 189.)

Mason & Oceana.—This company, which operates 27 miles of narrow gage road from Buttersville, Mich., southeast to Walkerville, according to a statement of President M. F. Butters, has made an agreement with Chicago capitalists to secure funds to change the gage to standard, and to extend the line from the southern terminus to Grand Rapids. Surveys are shortly to be started and right of way secured.

Morgantown & Southern (Electric).—An officer writes that this company, which was recently incorporated in West Virginia, will probably let contracts next month for building its proposed line from Morgantown, W. Va., southwest to Fairmont, approximately 28 miles. J. W. Wiles is President and J. R. Johnson, Chief Engineer, both of Morgantown. (Oct. 5, p. 91.)

North Coast.—Robert A. Strahorn, President of this company, says that the proposed line between Spokane and the Puget Sound country will form connections with the Chicago, Milwaukee & St. Paul on Cow creek, about 30 miles southwest from Spokane; the Union Pacific and the Northern Pacific to Connell, Wash., with the Chicago & North-Western via its Walla Walla line across the Snake river near the mouth of Salmon river, with the Spokane-International, a branch of the Canadian Pacific at Spokane, and with the Western Pacific by way of the Portland line. Construction work on the line is to be pushed westward. Financial arrangements have been completed through New York and Washington capitalists. J. G. White & Co., of New York, will be consulting engineers. (Aug. 3, p. 31.)

Oregon Short Line.—A contract has been given to Corey Brothers, of Ogden, for extending the line from Twin Falls, Idaho, west to Buhl, 17 miles. Work is to be started at once and completed by next spring.

Roscoe, Snyder & Pacific.—Incorporated in Texas with $200,000 capital and office at Roscoe, in Nolan County. The incorporators propose to build a line from Roscoe, on the Texas & Pacific, northwest through Nolan, Fisher, Scurry, Borden, Garza, Lynn, Lubbock, Hockley, Cochran and Bailey counties to the New Mexico border, about 200 miles. F. W. James, W. G. Swenson, J. E. Will, of Abeline, Tex.; M. T. Reede, of Hutchinson, Kan., are interested.

St. Clair Terminal.—Contracts have been given by this company to T. B. Murphy and the American Bridge Co., of Pittsburg, Pa., to build a connecting link 3,340 ft. long from the St. Clair Terminal Railroad, controlled by the United States Steel Corporation, to the West Side Belt at Clairton, which is part of the Wabash System. The line is completed for three-fourths of the distance and track laid for one-half. The work includes an expensive steel viaduct 1,000 ft. long to carry two tracks.

St. James Bay.—See Canadian Northern.

Springfield Railway (Electric).—This company has been granted a 25 year franchise for a two-mile extension of its system through the factory district of Springfield, Ohio.

Temiskaming & Northern Ontario.—Contracts for clearing and grading new lines have been let by this company as follows:

Charlton branch, Englehart to Long Lake, eight miles, to the Canadian Construction Co., of Montreal.

Kerr Lake branch, Cobalt to Kerr Lake, four miles, to A. Spencer, of Niagara Falls, Ont.

Haileyburg spur, Haileyburg wharf to main line, 1.75 miles, to McQuigg & Hunt, of Arnprior, Ont.

Texas, Oklahoma & Northwestern.—This company, which was organized last year to build a line in Oklahoma, has completed some of the surveys, but has been unable to do any work for lack of funds. It is said the project has been taken over by new parties, including Patterson Bros., of Benton, Mich., and others of Taloga, and that work will soon be started on a line from Thomas, on the St. Louis & San Francisco, northwest to Taloga, 30 miles. It is intended to eventually continue the line in a northwest direction. (See Construction Record.)

Toledo & Indiana (Electric).—This company, operating 56 miles of road from Toledo, Ohio, west to Bryan, according to Toledo reports, has made arrangements for the extension of its lines westward from Bryan to Waterloo, 25 miles. Such a line would fill in the last gap in a continuous system of electric lines between Chicago and Erie, Pa. It is expected that the line will be completed by the end of 1907. From Toledo eastward there is a chain of electric roads, including the Lake Shore Electric to Cleveland, and the Cleveland, Painesville & Eastern, from Cleveland to Erie, Pa. A new line is now under construction from Erie to Buffalo. When this line and the line between Bryan and Waterloo are completed a continuous system will exist between Buffalo and Chicago.

Western Pacific.—Track has been laid by this company west from Salt Lake for about 70 miles, and the work is progressing steadily westward. It is understood that the right of way through Nevada, where much of the route is surveyed through lands owned by the Southern Pacific, will be adjusted satisfactorily. From Winnemucca to Wells and along the territory drained by the Humboldt river, the road is surveyed largely through Southern Pacific property. This, however, will probably not delay much longer the letting of contracts for the construction of the Western Pacific through Nevada. President E. T. Jeffrey says that it is expected

to have the road in operation from Salt Lake to San Francisco and Oakland by May, 1908. Only a continued shortage of labor would be likely to delay the opening. Over 6,000 men are now at work on the grade, but about 7,000 more are needed at once. The question of entering Sacramento, either by an overhead route or by a subway, has not been decided. There will be several points at which the numerous Southern Pacific tracks must be crossed. Work has been started on the long steel bridge across the American river at Sacramento.

RAILROAD CORPORATION NEWS.

Albany & Susquehanna.—See Delaware & Hudson.

Atchison, Topeka & Santa Fe.—In an interview in connection with the recent raising of the annual dividend rate from 4 per cent. to 5 per cent., the president of this company gave the reasons for his opposition to a dividend higher than 5 per cent. He said that such work as double-tracking could properly be charged to capital account because it enlarged the capacity and earning power of the road, but there are always certain expenditures which must be made to provide better service and more safety, which do not bring in greater earnings and so must be met out of income. Reduction of grades and elimination of curves must go on indefinitely and, as they ultimately increase the earning power of the road, they can be regarded as an investment of the stockholders' money.

Baltimore Terminal Co.—See Baltimore, Washington & Annapolis.

Canadian Northern.—The Western Estates, Ltd., has been incorporated in Canada to manage the Canadian Northern's lands. Of the land grant of 2,455,460 acres, about 1,500,000 were to be sold from time to time and the remainder were to be held as security for the account of the Manitoba Government in connection with guarantees and for the account of the Dominion Government as security for a mail contract subsidy. Two years ago it was said that the railroad had agreed to buy from Manitoba 256,000 acres of the Hudson's Bay land grant for $156 an acre.

Chicago, Milwaukee & St. Paul.—This company has asked the New York Stock Exchange to list $25,000,000 additional common stock, this being the amount offered to stockholders recently. The proceeds are to be used as follows:

Additional equipment	$11,419,311.58
Second track	2,310,358.24
Improvements—Milwaukee and other shops	1,374,639.59
Coal lands and shafts in Iowa and Illinois	1,418,737.37
Real estate	251,553.42
Other improvements	1,333,743.66
About 300 miles new road in Wisconsin, South Dakota, Minnesota and Illinois	4,859,347.89
Sidings, bridges and other improvements	2,032,994.43
Total	$25,000,686.18

It has been widely reported that at the annual meeting on September 29 increases of $75,000,000 in preferred stock and $75,000,000 in common stock were authorized. No official confirmation of this action is obtainable.

Chicago Southern.—This company is to issue $5,000,000 bonds for the purpose of refunding $4,000,000 outstanding 5 per cent. notes; the rest will be used to complete the 40-mile line between Chicago Heights, Ill., and Quaker Hill, Ind., which is the western terminus of the Southern Indiana, a road owned by the same interests. Twenty-two miles of this distance have been built and most of the grading on the remaining 18 miles has been done. When completed, the two roads together will extend from Westport, Ind., to Chicago, the entrance into Chicago having been arranged for by an agreement with the Chicago Terminal Transfer Company.

Cincinnati, Hamilton & Dayton.—The gross earnings for the year ended June 30, 1906, were $8,398,418, an increase of $389,501; operating expenses increased $590,408, leaving net earnings of $1,486,983, a decrease of $200,907; the deficit after fixed charges was $1,352,401, which compares with a deficit of $503,294 in 1905 and a surplus of $404,292 in 1904. During the year the bonded indebtedness was increased $197,000, and $511,830 receivers' certificates were issued to pay interest due January 1, 1906, on bonds of a subsidiary company. The profit and loss surplus on June 30, 1906, was $1,769,031.

Delaware & Hudson.—At a meeting of the stockholders of the Albany & Susquehanna on October 15, the retiring board of directors, representing Delaware & Hudson interests, were defeated for re-election by a group of independent stockholders. These stockholders have been opposing the plan of the Delaware & Hudson to refund the $10,000,000 A. & S. 7 and 6 per cent. bonds falling due on April 1, 1906, with an issue of 3½ per cent. bonds convertible up to 1916 into D. & H. capital stock at the rate of 5 shares of stock for $1,000 bonds. The A. & S. runs from Albany to Binghamton, N. Y., 142 miles, and forms this part of the main line of the Delaware & Hudson, which leased it in 1870 for an annual rental of 7 per cent. on its capital stock. The D. & H. also guaranteed the bonds of the other company. In July 1902, the rate paid by the D. & H. was increased to 9 per cent., this to continue until the expiration of the lease on April 19, 2001. The protective committee representing the stockholders who voted against the Delaware & Hudson interests declares that the lease provides that any saving in interest on the Albany & Susquehanna bonds shall be added to the annual rental. With the present refunding issue this saving amounts to $222,500 a year. For a number of years there has been a saving of $35,000 annually, but no claim has been made. It is announced that the new board will press these claims at once.

Grand Trunk.—At the semi-annual meeting, the president announced that it was expected that an increased dividend would be announced at the annual meeting, to be held next spring, on the $34,765,000 outstanding third preference four per cent. stock, on which one per cent. was paid in 1902, two per cent. in 1903, nothing in 1904, and two per cent. in 1905. He further stated that on account of the increase in taxes on imported rails, renewals would cost $1,250,000 more if the company continue to buy rails in the United States, and that under the same conditions there would be an increase of $4,000,000 in the estimated cost of building the Grand Trunk Pacific.

Hocking Valley.—The attorney-general of Ohio has begun a quo warranto suit seeking to annul the franchise of this road. It is charged that the Hocking Valley and the Toledo & Ohio Central, which are parallel and competing roads, are owned by the same corporation. Both companies have lines from Toledo south to Athens, via Columbus, and in June, 1901, the Hocking Valley acquired all but $54,100 of the $6,500,000 common stock of the Toledo & Ohio Central, and all of the $3,708,000 preferred stock except $11,600.

Gulf & Ship Island.—With an average mileage operated of 284, as compares with 275 in 1905, the gross earnings of this company for the year ended June 30, 1906, were $2,138,778, an increase of $261,381; net earnings, $631,667, an increase of $201,512. The surplus after charges was $401,275, an increase of $221,825.

Lake Erie & Pittsburg.—As announced in our "Elections and Appointments" column this week, officers of the New York Central have been elected officers of the L. E. & P., although no official announcement has ever been made that New York Central interests were behind this new road. It has been completed from Lorain, Ohio, southeast to Berea, 13 miles, and it is to be extended from that point northeast to Cleveland. Contracts were recently given for extending the line from Metz to Youngstown, Ohio.

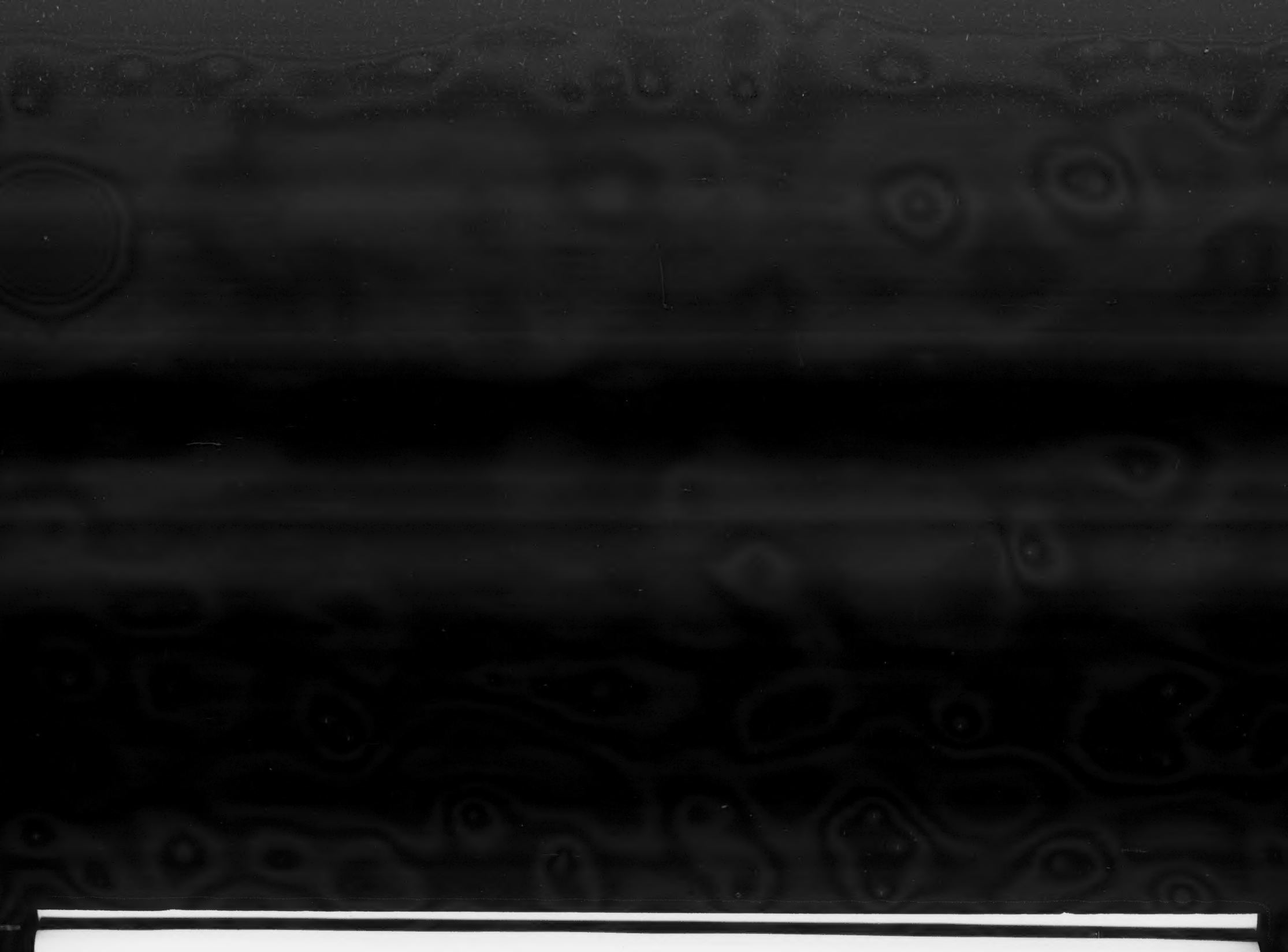
New York Central & Hudson River.—See Lake Erie & Pittsburg.

Southern Indiana.—See Chicago Southern.

Thomasville & Denton.—This 15-mile road, which was recently completed between Thomasville, N. C., and Denton, has been sold to W. T. Van Brunt, New York City, and associates. It is proposed to extend the road.

Toledo & Ohio Central.—See Hocking Valley.

Tonopah & Goldfield.—Extra dividends of 10 per cent. on the $1,650,000 common stock and 10 per cent. on the $500,000 7 per cent. non-cumulative preferred stock of this company have been declared, payable November 1, 1906. Previous dividends on these stocks have been as follows: Dividends of 3½ per cent., which were declared on the common stock, payable May 1, 1906, and August 1, 1906; dividends of 3½ per cent. declared on the preferred stock, payable May 1, 1906, and November 1, 1906.

Union Pacific.—Gross earnings for the month of August, 1906, were $6,283,775, an increase of $525,038; net earnings, $3,004,687, an increase of $32,496. Gross earnings for the two months ended August 31 were $12,573,528, an increase of $1,359,079; net earnings, $6,102,392, an increase of $751,311. The average mileage operated during the period was 5,578, an increase of 223 miles as compared with the same period in 1905.

Washington, Baltimore & Annapolis (Electric).—The stockholders of this company will meet on November 2 to authorize an increase in the capital stock from $4,000,000 to $5,250,000. The company is building an electric line from Baltimore to Washington, 31 miles, and it proposes to get its entrance into Baltimore through the Baltimore Terminal Company, which is building a line from a point near Clifford Junction on the route of the W., B. & A. north to Baltimore, and has a franchise and nearly all of the necessary right of way in that city. The new capital to be authorized by the W., B. & A. is to be used in connection with the terminal company.